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Ruminant Supply Chains in Mongolia

A preliminary assessment of strategies for improving returns, risk management, and productivity

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Ruminant Supply Chains in Mongolia

A preliminary assessment of strategies for improving returns, risk management, and productivity

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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Executive Summary

Background

Livestock raising and marketing remain among the most socially influential activities in Mongolia. In addition to its historical and cultural importance, livestock secures not only the national food supply but the livelihoods of extensive populations of pastoralists and small enterprise intermediaries. After a long and continuous history of adaptation, emerging trends are changing the strength, weakness, opportunity, and threat (SWOT) conditions facing small herders in Mongolia. Most prominent among these changes are expanding demand, pastoral resource sustainability, and demographic transitions. As the risks facing the sector have changed, policies have adapted to better protect its stakeholders. In the following assessment, we review these developments and suggest supporting strategies to improve livestock sustainability and livelihoods in Mongolia.

Methods and Data

Contrasting historical practices with new sustainability challenges, this report assesses emergent risks for Mongolian livestock producers, particularly small-scale herders, and their implications for national food security. Our approach has been to combine extensive background material from the relevant literature, official data sources, and direct field observation to construct a balanced, comprehensive, and up-to-date review of sector conditions. The analysis is intended to place Mongolian herders in the context of the challenges and opportunities they face in the rapidly changing environment that is today's Mongolia. Based on this empirical assessment, we conclude with a series of recommendations for policy consideration and further research.

Results

The general findings of this assessment, consistent with present day official and independent perspectives, are that livestock supply chains in Mongolia remain ill-equipped to deal with expected sector transitions. In particular, the majority of producers will not fully capitalize on the potential of growing demand for livestock products unless more sustainable means of herd expansion and management of herd composition are achieved. Secondly, investment strategies for small-scale herders need to be better supported by risk management mechanisms to avoid under-investment in product quality and livelihood risk arising from weather shocks.

Conclusions and Recommendations

This review of Mongolian livestock keeping yielded two types of recommendations, one for supporting policy initiatives and one for further research to make overall policy more effective. These are summarized in the boxes below and discussed in detail in the penultimate section of the report.

Policy Recommendations

1. Extend the index-based livestock insurance (IBLI) scheme with a separate voucher or conditional cash transfer programme to promote participation by poorest herders
2. Assist existing efforts to reduce the impact of *dzud* by promoting institutions that facilitate short term long-distance migration in response to extreme weather events
3. Focus public investment in value chain development on meat and hides (rather than fibre)
4. Avoid futures contracts for livestock products

Research Recommendations

1. Pilot studies on 'Incentive Compatible' cash grants to stimulate value chain development
2. Ex-ante impact assessment for projects aimed at increased participation in the IBLI and / or hide value chain development

Introduction

In all its aspects, the livestock sector remains one of the most influential in Mongolia, playing critical roles in economic, social, and cultural activity. A significant percentage of the population still rely on livestock as the foundation of their subsistence and livelihoods, directly in animal production (mainly smallholder herding) or indirectly, participating in supply chains for livestock products, including animals, meat, hides, cashmere, wool and dairy products.

Mongolian livestock is also a sector characterized by high and persistent levels of systemic risk. Extreme weather shocks, called *dzud,* are frequent, occasionally killing millions of animals in a single winter, putting thousands of pastoral families out of business, and threatening the domestic food security. To manage these risks, Mongolia's livestock producers have developed a tripartite hedging strategy: adapting with respect to location, species, and product. Recent and anticipated changes in the country, however, are threatening the viability of these traditional strategies. Pasture degradation, initiated by increases in animal populations and exacerbated by climate change, can increase the severity of *dzud* losses, with concomitant adversity for pastoral producers, their dispersed communities, and their downstream supply chain counterparts.

Based on a combination of direct field observations and secondary source material, this report examines history, present conditions, and prospects for sustaining and developing livestock supply chains in the country. With detailed supply chain audits, we seek to elucidate the complex interplay of differentiated production systems, animal varieties, and animal products, as well as the mosaic of supply chain relationships that bring these products from the country's resource base to final consumers. At present, most of these networks consist of small scale family producers and low income, small enterprise intermediaries. For this reason, our findings regarding risk management and livelihoods in this sector have important implications for the most vulnerable populations in Mongolia. This vulnerability/poverty aspect of livestock sector issues, combined with the essential nature of the products involved, means that policy toward this sector touches on an unusually large number of MDG metrics for national economic progress.

Generally speaking, a variety of options are open to the Government of Mongolia to promote more effective smallholder risk management. These build on existing initiatives and institutions, and also suggest new directions for sector support. Taken together, our assessment of the relationship of risk to smallholder livestock portfolios attempts to elucidate the key challenges the rural poor face in the national livestock industry. This information is intended to support policymakers in developing strategies to reduce smallholder vulnerability herders and promote more inclusive national market participation.

The next section provides historical background on the sector, including a brief description of Mongolian transhumance and its historical development from its roots before the times of Chinnghis Khan to the present day. This is followed in section 3 by a description of agents and agency relationships in the Mongolian livestock production system, and diagrams the flow of animal products from producer to

consumer. It emphasizes the role of middlemen, “changers,” in the Mongolian livestock industry. Section 4 discusses the role of risk and incentives, with particular reference to herder investment decisions and marketing behaviour. These background and conceptual elements are then complemented with primary and secondary data on the sector, including direct interview data with supply chain actors and a range of official statistics. In section 5, we use this synthesis to review existing risk management interventions in the sector and make recommendations for new supporting policies and further research to improve policy effectiveness. A final section presents concluding remarks.

A Brief History of Mongolian Livestock Production

There is limited information regarding the livestock production system before the socialist revolution, but it seems that, with the exception of the Soviet period, Mongolian herders have used mobility and mix of species as an approach to risk management since before the rule of Chingghis Khan in the 13th century. This has been in a context of incrementally decreasing territorial fluidity and increasing formal institutional authority (Fernández-Giménez 1999). These incremental institutional changes, coupled with industrial revolution, have limited the ability of herders to utilize the 'mobility hedge', but have also presented new opportunities for income and risk management in the form of the 'output / product hedge'.

Chinnghis Khan was the first leader of Mongolia with the power to impose a system of fiefdoms in the country with the right to extract labour and taxes. His reign was the first time that herders were bound to any particular territory or ruler, though they could change allegiances and thereby territory (Jagchid and Hyer 1974). The population was organized into tribal units called *Khurree*. While the origins and reasons for organization are unclear, it seems that their purposes were both economic and defensive (Bold 1996). Land use decisions, essentially the decision to engage in seasonal migration, were determined by *Khurree* chiefs. During this period, the *Khurree* had the ability to make wide seasonal migrations, which would have allowed them to take advantage the pasture management benefit of the mobility of their animals. Formal institutions outside the *Khurree* were limited. Chingghis Khan and his successors bestowed political leadership upon allies. A customary law of the steppes provided a system of informal regulation (Fernández-Giménez 1999).

The Manchu period (1691 - 1911) saw the development of many of the political institutions that exist into modern day Mongolia. The Manchus imposed a system of colonial rule on to the existing social structure. They organized the country into a system of 100 military-territorial units. This system seems aimed at breaking the power of the existing local leadership, and not at effectively managing the territories. Within these territories, herders informally organized into a system of *bags*, 50-100 households that migrated together. Under these existed neighbour groups called *khot ail*. The families within these units would pool their livestock together into larger herd. This saved on labour resources and acted as a safety net. Poorer households could seek assistance from the richer households in the *khot ail* in exchange for labour (Bold 1996). This acted as a form of consumption smoothing in the face of shocks, almost like an informal lender in settled farming systems. Resources are given on credit, but instead of the medium of exchange being cash, it is labour.

The *bags* still had a wide range of territory, but individual herders were bound to a particular territory and group, called a *nutag,* and the bags themselves were more limited in migration territory than the previously existing *khuree*. Manchurian administrators did recognize that weather shocks precipitated a need for lon*ger*

distance migration, and codified a limited right to such actions (Fernández-Giménez 1999).

The Manchus codified many aspects of Mongolian customary law, including the existing first come, first serve principle of herding campsites, restriction of grazing on religious lands, and water rights. Land use decisions were made by the Manchurian nobility, but were limited in scope. Heterogeneity of local environments and high transportation costs limited the efficacy of top down management to putting boundaries on movements and activities, and allowing the *khot ail* to manage their own affairs.

Socialist Period

The socialist period saw both the collectivization and specialization of livestock production. During this period, the Mongolian livestock industry became dependent on subsidies from the United Soviet Socialist Republics, and abandoned its traditional risk management strategies.

After a period of occupation by the Beiyang led Republic of China, the Mongolia People's Republic (MPR) was founded in 1921, with support of the ousted White Russian Army. The MPR first attempted collectivization in a period called the "Left Deviation" from 1929 to 1932. The livestock assets of the nobility were confiscated and redistributed. This attempt at collectivization ultimately failed, and led to massive disruption in Mongolia's livestock production. Herders began to slaughter livestock or smuggle their animals into China in order to avoid confiscation, which caused the MPR government to back off its policy of forced collectivization. In the 1950's attempts at collectivization by utilizing tax policy and other incentivizes saw more success. By 1960 over 99 percent of herders were participating in collectives (Rosenberg 1977).

The collective system, or *negdel*, broke the traditional social set up of Mongolia. The *khot ail*, which acted in part as a social safety net by allowing poorer herders to engage in a form of consumption smoothing on credit with the wealthier households in their group, was replaced with one or two household units called *suur*. This system was specialized, with each *suur* raising only one species of animals, limiting adaptation and risk management services provided by livestock in the traditional transhumant system. Herders became salaried and received vacation benefits. Performance was incentivized by rewards and demerits (Fernández-Giménez 1999).

In addition to building schools, health clinics, and other basic infrastructure in newly established *soum* (small administrative district) centers, the MPR engaged in several initiatives to develop the livestock industry. These often had unintended consequences in terms of risk management and overall sustainability of the system.

1. Specialization: While specialization might have broken one of the main forms of traditional risk management, it was likely intended as a means to increase production.

2. Winter shelters: The MPR government organized the construction of winter shelters. These structures did help reduce animal deaths resulting from *dzud,* thereby providing a physical capital solution to weather shocks. But they also increased the potential for the spread of disease due to poor cleanliness. Perhaps more detrimental was that these large structures acted as a de facto encouragement to return to the same winter and spring pasture every year in order to take advantage of the shelters (Fernández-Giménez 1999). This limited the recovery time of local pasturelands, decreasing the ability of local environments to sustain herds.
3. *Otro*: While the practice of *otro*, long distance short term migration, already existed, the practice was formalized by the socialists. During the collective period, *negdel* administrators would require members of herder households to engage in *otro* in order to ease the impact of harsh winters and to fatten livestock in the summer and autumn. This created friction between *negdel* administrators and those herders who did not wish to participate (Humphrey 1978).
4. Veterinary services: Before the founding of the MPR, Mongolian herders predominantly relied on traditional medicine. During the collective period, veterinary services were organized by the state. Strategies were very top down, with information and resources coming from the center and passing through varying levels of local government. Veterinary services were relatively successful in reducing animal deaths. Several infectious diseases were brought under control between 1947 and 1980. Control measures were also undertaken against parasites (Edstrom, Zanaa and Baljinnyam 1993).
5. Hay and fodder: The MPR compensated for the forced loss of mobility resulting from the *negdel* system and resulting loss of adaptive capacity by instituting supplementary fodder programmes, most important of which was the State Emergency Fodder Fund. Originally intended as a coping mechanism for *dzud*, herders soon became dependent on the programme's heavily subsidized feed as a regular source of feed (Suttie 2006).
6. Industrialization of non-meat livestock products: It is unclear to what extent non-meat products were traded before the formation of MPR in 1921, or what role they played in the economy of the early collectivist period, but by 1970's the government of the MPR began centralizing the processing of non-meat livestock products. Two cities, Darkhan, focused on leather, and Erdenet, focused on carpets, were founded, and the industrial capacity of Ulaanbaatar was expanded. State enterprises were established, many of which still operate today.

Post-Socialism Economic Transition to the Present

In 1990, Mongolia became a democracy, and abruptly moved to free market capitalism. This meant the dissolution of *negdels*, and the privatization of livestock (Fernandez-Gimenez: 2006). The fall of the USSR meant the loss of financial backing

for the Mongolian government, an economic shock that meant the loss of about the equivalent of a third of the country's GDP. Public sector employment was significantly cut. This additional labour was partial absorbed into herding and the informal sector, with the remaining increasing the unemployment rate (Mearns: 2004).

After the transition from a controlled economy, the headcount of livestock increased substantially, mostly driven by an increase in goat populations (Mearns: 2004, National Statistics Office Mongolia: 2013).

In 1999 to 2002, and again in 2010, the country was besought by devastating winter *dzuds*, which decimated herds, and ruined herder livelihoods.

Ruminant Supply Chains

The output of the Mongolian livestock industry consists of five major products: meat, hides, cashmere, sheep wool, and dairy. Additional products, namely organ meat, yak wool and camel wool, represent niche products. These niche products can be developed into larger money makers for herders and industry, but are currently still emerging from the fringes.

This audit first describes the methods used to undertake the value chain study, and discusses biases that likely result. It then continues by describing the different market actors in the Mongolian livestock industry. Thereafter it presents the various paths that exist in Mongolia for providing meat to the consumer: herder household consumption, direct sale to consumers, sale to market vendor, sale to *aimag* changers, sale to product changers. Finally, it follows the other products: hides, cashmere, sheep wool, and dairy, from the point of rendering to the consumer or export.

Methodology

This study utilized both qualitative and quantitative interviews in trying to determine the value chains of the Mongolian livestock industry. Both sets of methods serve complimentary functions.

This inquiry began by gathering qualitative information and gradually moved to the quantitative. The qualitative method used most often was the informal interview. Interviewees were asked a series of standard questions and then follow up questions were asked based on their answers. When conducted in a group setting, what started as an informal interview would often transform into an informal focus group, with lots of debate among participants.

As the study progressed and it became feasible to conduct more interviews targeted at understanding investment in livestock and rates-of-return, a tiered survey was designed to target each actor along the supply chain. Previous work conducted in Southeast Asia to elucidate the role of middlemen in the chicken market for the purposes of determining traceability of animals in the context of Highly Pathogenic Avian Influenza and the feasibility of contracting, served as the inspiration for the Mongolian livestock industry value chain study (Heft-Neal et al: 2012). These previous studies focused primarily on disease problems caused by middlemen mixing poultry flocks as they collected stock for resale.

The value chain study in Mongolia focused on three interrelated aspects of the livestock industry: risk, substitution, and rates-of-return to herders and other actors. These quantitative interviews were often augmented with questions of a more qualitative nature.

Identities of those interviews were kept anonymous in an effort to elicit more honest responses, the theory being that those interviewed would be less inclined to

obfuscate their business practices if they knew that their personal information was not going to be publicly attached to them.

New technology allowed this survey to build upon the previous studies conducted in Southeast Asia. While survey questions were delivered verbally by Mongolian interpreters, observations were recorded electronically using a form designed on the Open Data Kit platform and displayed on an Asus Nexus Android tablet. This platform had the advantage of a branching logic functionality which displayed questions based on previous answers, making collection more efficient by eliminating irrelevant questions for particular observations. This provided a great advantage in the context of a value chain survey where actors at different points have very different roles. It had the disadvantage of being difficult to adjust in the field. Geodata was collected with a Garmin Etrex 20 GPS. The survey was translated into Mongolian, with English versions of the questions available for display if the enumerator preferred.

A review of the literature on transhumant systems, Mongolia and livestock economics was conducted before, during and after field research. Interviews with policymakers, NGO workers, and academics were conducted to augment understanding and to elucidate policy problems. Additional statistical data was gathered from the Mongolian National Statistics Office, the Mongolian Agricultural Commodities Exchange, the World Bank, and the International Monetary Fund.

Sample Design

Snowball sampling, also known as chain referral sampling, was utilized to recruit interview subjects (Goodman: 1961, Faugier and Sargeant: 1997). This produced three main cost savings for the project. First, utilizing the network solved the information problem of finding a capable interpreter. When one hires an interpreter, or any employee, one faces a lack of information regarding the person's work habits, abilities, and temperament. Typically, international development projects solve this information problem by paying a premium for translation and interpretation services, and hiring urbanites instead of target members of target communities. By mobilizing Peace Corps networks, the project was able to find excellent interpreters who had an intimate knowledge of the community of study. Second, many network members were willing to host the project worker at their home, saving project financial resources. Third, Peace Corps Volunteers have an intimate knowledge of their host country's low cost public transit systems. While time consuming, utilizing public transport saved the project from having to hire its own vehicles when moving between project areas.

The use of snowball sampling might be subject to a community bias and a lack of representativeness. The potential community bias results from the first participants selected and a lack of time to build relationships in the targeted communities of value chain actors. A lack of representativeness could result from the nonrandom nature of the sample. Snowball sampling is nonrandom in that it mobilizes social

networks. But social systems, like value chains, are beyond a researcher's ability to randomize.

The results of this research are also likely biased by the limiting of interviews to areas near town centers. A sophisticated observer of Mongolia described it as a "small country with large distances (Bielman: 2013)." The population of Mongolia is very sparse. The country's population is only 2.9 million; transportation costs are great in a country of 1 564 116 km^2 or approximately twice the size of the state of Texas with very limited road infrastructure. "Tarmac bias" (Chambers: 1981), or the propensity to stay near developed infrastructure when conducting surveys, was noted as a concern at the outset of this study. In order to combat this bias, multiple weeks were spent at 1 000+ km from a town of 50 000. The furthest point of observation was 50 hours away from Ulaanbaatar by public bus. Over 130 hours were spent on intercity travel. Yet transportation costs, and sheer inavailability transportation options to anywhere other than the capital, still limited the ability to collect observations far from *aimag* centers, also known as provincial capitals. Multiple day trips were spent collecting observations away from *aimag* centers, but all but two days were limited to two hour drives, and did not include any investigation to *soum* changers, small scale local equivalent to *aimag* changers. As a result, rates of returns might be biased upwards because of real higher returns to herders near the *aimag* center which might result from a combination of reduced transportation costs for herders, reduced transportation costs for *aimag* chan*ger*s when shipping goods to Ulaanbaatar (*aimag* centers typically have larger, or even paved, roads between them and Ulaanbaatar), and competition among multiple buyers versus the monophony of a one changer *soum* center.

Limited time made formal training of interpreters/enumerators infeasible. This might produce biases by creating variations in the data that appear to be regional but are actually due to an enumerator's unique understanding of a particular question.

Interview questions attempted to define margins for intermediary actors by focusing on the costs of a good to that actor, but forgoing asking for the resale price. This was due to the tendency for individuals to obfuscate their profits, but being comfortable discussing their costs. Still, while the assessment of returns to herders are considered accurate, as well as the market price of meat, the heterogeneity and obfuscation make the margin breakdowns between levels noisy.

With these caveats in mind, the results of this study should be interpreted qualitatively.

Actors on the Mongolian Livestock Industry Value Chain

There are several different types of actors on the Mongolian Livestock Value Chain. Each provides essential services to the current process of moving livestock products from the distant parts of Mongolia to the consumers both domestic and abroad. Any attempt to develop the value chain and increase returns will have to engage multiple, if not all, of these actors.

1. Herders—Herders are the raw material producers. They raise livestock for food and also to sell the products derived from these animals, hides, fibers, and dairy, as well as some of the animals themselves.

2. Changers—Changers are middlemen that are located in either town markets or urban areas with stationary store fronts. They provide two essential services to the Mongolian livestock industry. First, they allow herders to sell large amounts of animals at once. Second, they incur the majority of transportation costs of moving animals from provincial town markets to the urban areas.

   Changers come in two main types: *general changers* that trade most if not all of the livestock products and *product changers* that only deal with one particular product. For example a *meat changer* would be one who only buys and sells meat. Product changers typically operate in the large urban areas of Ulaanbaatar, Erdenet, and Darkhan, while the general changers work predominately in provincial town markets or *soum* centers.

3. Collectors—In many ways the antithesis of the changers, collectors travel throughout the countryside to purchase livestock and livestock products. They are opportunistic, making deals with herders they find as they travel. Collectors allow herders to avoid the costs of moving livestock to *aimag* centers, but do not provide herders with a means of liquidating assets on-demand. Collectors seem heavily engaged in the trade of animals and cashmere. It is unclear as to how much they participate in the wool and hide markets.

4. Local Market Vendors—Local market vendors are the primary point-of-sale for food stuffs in urban areas. Local markets typically offer a variety of goods, but the most important vendors for the livestock industry are butchers and dairy resellers. Both sets of sellers can be found in large open indoor markets.

5. Domestic Factories—Mongolia has domestic factories for leather clothing, cashmere textiles, and wool. These factories produce goods for both the domestic and international market.

6. Slaughterhouses—A few of the *aimag* centers and two districts of Ulaanbaatar, Emeelt and Nalaih, have slaughterhouses for the purpose of processing meat. Some of these slaughterhouses purchase meat from the herder or *aimag* chan*ger* in order to process and resell. Other slaughterhouses slaughter, skin, and remove the bowels for a fee.

7. International Traders—International traders engage with the Mongolian market in the livestock trading areas near Ulaanbaatar. *Aimag* changers and collectors come to Ulaanbaatar to access these international traders, or the "porter" changers who acts as a middleman between these traders. Observed market transactions with international traders involved hides.

Livestock Product Flows from Herders to Consumers

The following sections present descriptions and graphical representations of the various pathways that livestock products can take from the herders and produce them to consumers. Arrows indicate the movement of animals or their products from one link on the value chain to another. Dollar signs ($) indicate points of sale. Blue boxes represent participants on the value chain during which the animal is alive. Red boxes indicate the point on the value chain that the animal is killed. Green boxes represent participants on the value chain that come into contact with the products after the animal has been slaughtered.

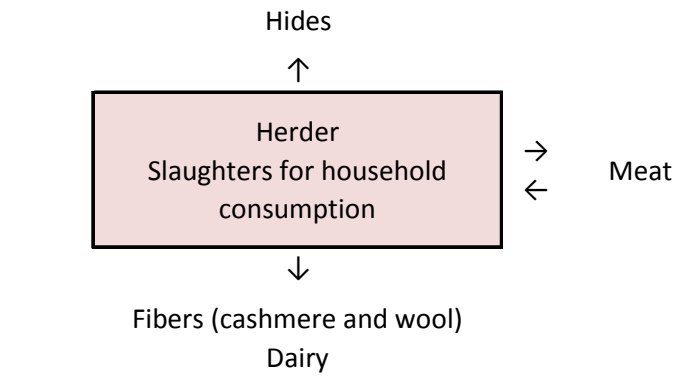
Live animals and Meat Production

In Mongolia meat represents an important source of food, a significant portion of the economy and an area of critical need for value chain development. Transportation costs are high and are often borne by a changer or collector. This represents a major challenge to both increasing returns to small herders, and improving the quality of animals and therefore meat. The limited ability to track animals that results from the changer system limits the power of demand-side incentivizes for quality meat.

There are significant seasonal differences in the flow of meat supply between those provinces with access to roads and those areas more on the outskirts of the country.

Lack of sanitary processing options in the meat industry represents another major value chain development need.

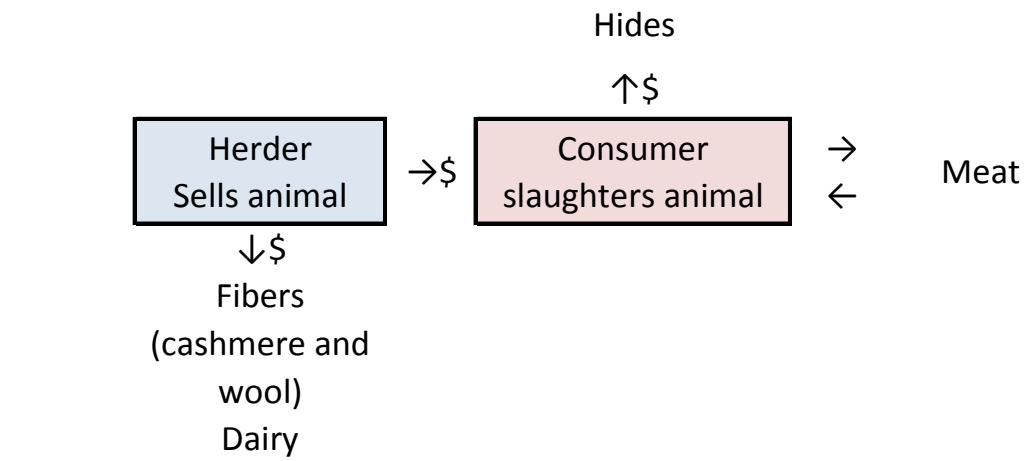
Figure 1: Herder Household Consumption



For herders, the method of deriving the maximum benefit of their production is to consume it themselves. They receive the benefit of consuming the meat, while being able to sell the hide for additional cash.

While herders are typically self-sufficient in meat production, they usually require other food items like wheat and vegetables. They also require other goods like fuel, clothing, and *ger* construction materials to sustain their livelihoods.

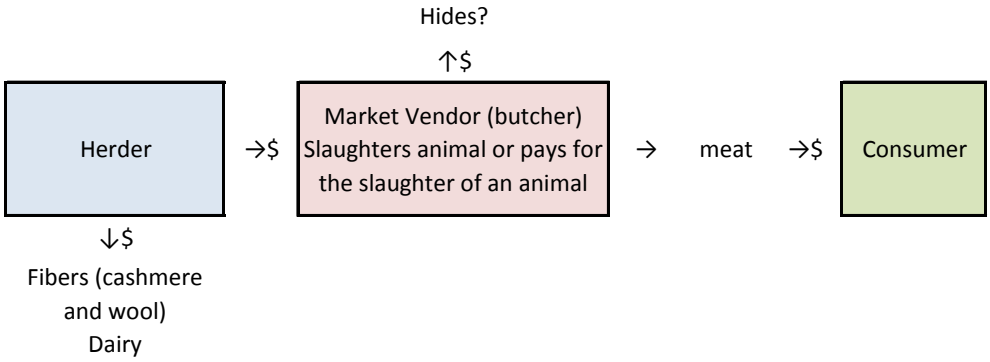
Figure 2: Herders Direct to Consumers



Many herders reported selling directly to consumers, either to family members who would come collect the animals where the herder was living, or by traveling to *aimag* centers. These transactions were typically small, numbering one or two animals. The benefit to herders from these small transactions is the high margin. Typically, herders could charge a higher price for animals that they were selling directly to the consumer than to an intermediary. The consumer benefits from paying a lower price for meat than at the market, or for a whole animal from an *aimag* chan*ger*.

If the customer was a relative or friend, both parties accrued value from the exchange beyond price. Herders in these transactions did not typically travel, instead their relations would come to them. This would save the herder the cost of moving the animals to the *aimag* market. Customers would know the source of their meat, and likely get a price better than they could at the *aimag* market, or even if they bought directly from a herder that they met at random. The customer would also be able to sell the hide of the animal to partially offset the cost of the animal's purchase.

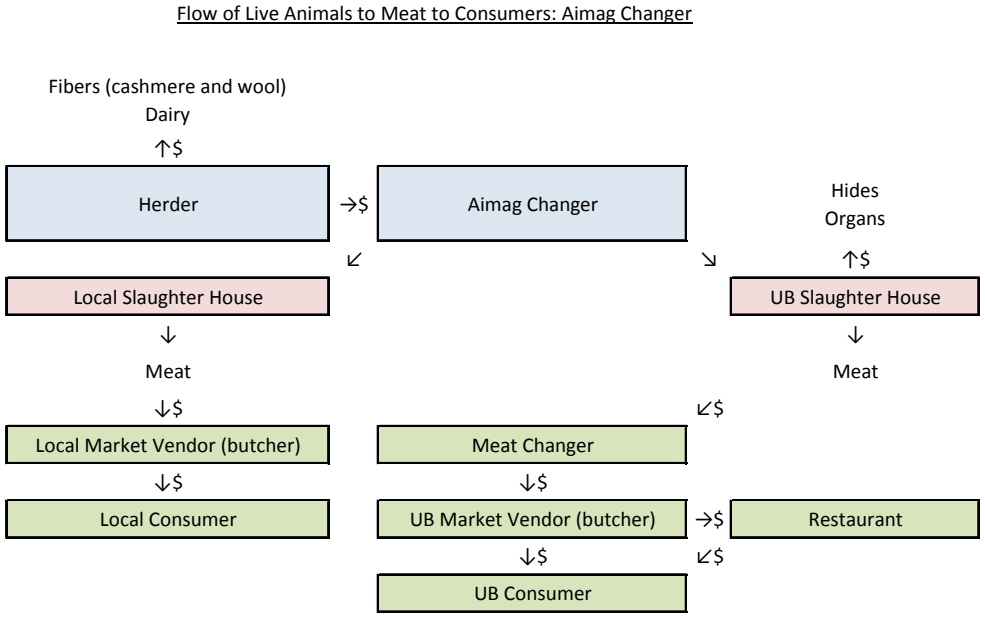
Figure 3: Local Market Vendor



Some herders also sell to local market vendors, namely butchers. According to interviews with butchers in Khovd and Ulliastai *aimags*, they will often have a relationship with a few herders, and will purchase animals from them as needed to keep up with sales (Khovd Butchers: 2013, Ulliastai Butchers: 2013).

Who received the hide for sale in these local market vendor transactions was not clear. Most of the butchers interviewed were women. These women also stated that it is a Mongolian cultural taboo for women to see the animal die. This meant that either the herders or the few men in these markets actually slaughtered the animal. Those interviewed did not state who owned the hide in these transactions (Khovd Butchers: 2013).

Figure 4: Aimag Changer



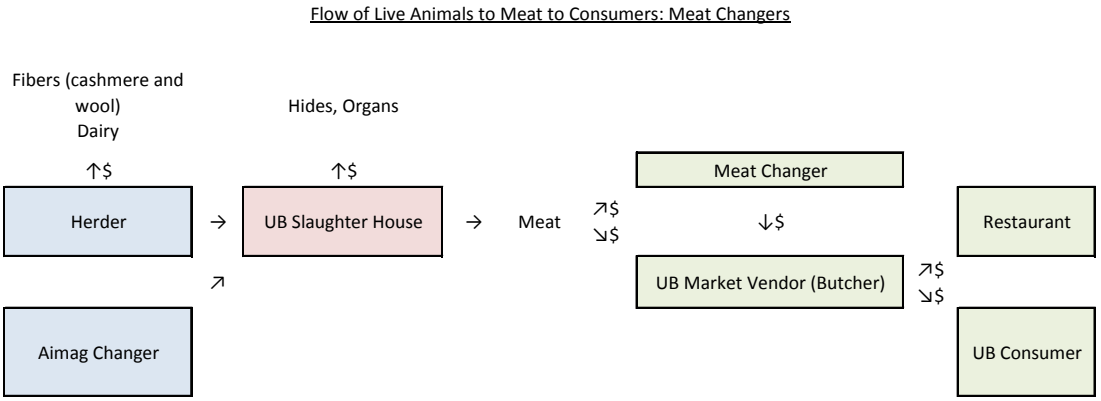
A very common transaction for herders is to sell to an *aimag* changer. *Aimag* changers act as middlemen. They will buy and sell animals in the *aimag* markets either to sell them locally, or to sell them to meat changers in Ulaanbaatar. These traders provide several essential services to the Mongolian livestock system. They provide a means for herders to liquidate a large amount of animal assets at once. Instead of selling one or two animals at a time, herders can sell dozens of animals at once, saving time and allowing them to respond to sudden shocks. *Aimag* changers also cover the transportation costs of moving animals from distant *aimag* centers to the capital city.

These services are provided by *aimag* changers for a price. *Aimag* changers pay herders a lower price for their animals than if the herder were to sell that animal directly to the consumer or a local market vendor, and then charge consumers or market vendors higher prices than they would have to pay if they bought directly from a herder (Ulaanbaatar Herder: 2013).

Aimag changers also engage in speculation with hides, wool, and cashmere. They purchase these products from herders and then wait for prices to increase. This raises the price of inputs for processors of these livestock products (Darkhan Nekki: 2013).

Aimag changers provide the critical service of moving products herders to the urban consumers, financing this intermediation by purchasing animals at farmgate prices and then selling them at a substantial mark-ups cost to processors. At this time, it is unclear how profitable this service is for *aimag* changers, but the mark-up itself represents a premium that could improve smallholder livelihoods with improved market access.[1]

Figure 5: Meat, Organ and Hide Changers

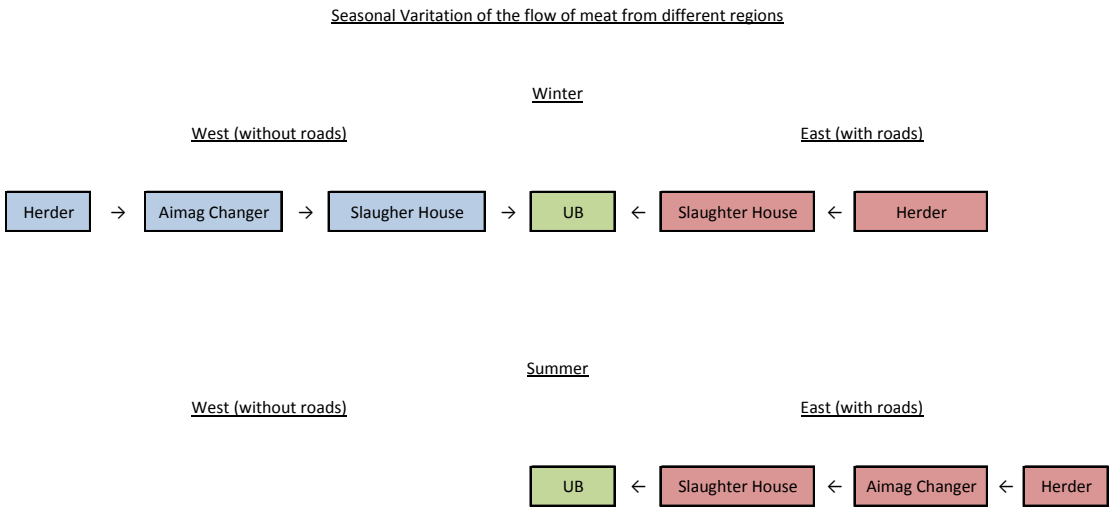


[1] Globally, there is increasing awareness that the margins accruing to livestock aggregators represents a market failure, discouraging smallholder market access and, via adverse selection, insufficient investment in product quality (see e.g. Zilbermand et al: 2012).

In the larger urban areas of Darkhan, Erdenet, and Ulaanbaatar, *aimag* changers and herders will often slaughter their animals for a fee at the local slaughter house, and then sell the meat, hide, and organs, to changers specialized in these products. These meat and organ changers then resell the meat and organs to local market vendors who then carve up the product and then sell it to consumers. Hides are sold to hide changers or to the porter changers and follow their own path to consumers of export, which is discussed below.

These transactions represent a major link of the value chain in need of development. Conditions observed at the slaughterhouse are extremely unsanitary. Most killing, bleeding, eviscerating, and skinning of animals is performed on a concrete floor. Live animals, and their dung, are kept in close proximity to where carving of the meat takes place. When tables are used, which is the case in the Erdenet meat changer market, the tables are slick with a thin film of blood, and small pieces of meat were observed in the crevices, despite no animals having been butchered for approximately 20 hours. These conditions violate even the basic guidelines for cleanliness and safety (Skaarup: 1985).

Figure 6: Seasonal and Regional Variation in the Flow of Meat



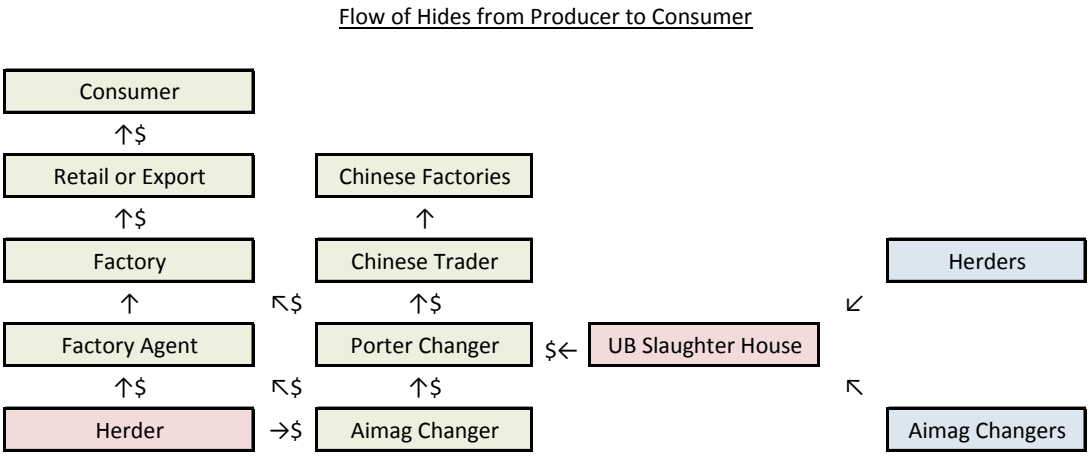
Different levels of developed road infrastructure, lack of refrigerated shipping options, and seasonal variation in prices create significant differences between the connected areas in Central and Eastern Mongolia, and the disconnected areas in the west.

Lack of road infrastructure and the great distances that need to be traveled in Western Mongolia impede herders in the region from providing their animals and animal products to the main urban areas in the center. For example, from Khovd to Ulaanbaatar is a little over two days by van over marginal roads. The time estimated by hoof is weeks. This causes herders in the west to be more dependent on changers that can overcome these transportation costs through scale. The lack of refrigerated transportation methods also limits the flow of meat from the west of the country to

the cold winter months, when ambient temperatures are significantly below freezing. Coupled with higher prices for meat in Ulaanbaatar during the winter, this makes supplying meat to the capital city feasible. But it still requires collecting enough product to justify the high transportation costs, which prices out small herders from directly providing meat to the center, and incentivizes collection of meat by a changer, who, by purchasing animals from a variety of herders, can achieve the scale necessary to cover these costs (Khovd Aimag Changer: 2013).

In the eastern *aimag* of Khentii, changers are more utilized in the summer, when the proximity of Ulaanbaatar enables the transport of carcasses from the *aimag* center to the capital city, but the lack of refrigeration limits the time that the meat stays viable for sale. During this time, herders limit sales of animals to amounts that will cover their cash needs. In the winter, the cold temperatures, high meat prices, and relative proximity to urban areas mean that herders can cover the costs of transporting animals at a scale they can supply (Khentti Aimag Changer: 2013).

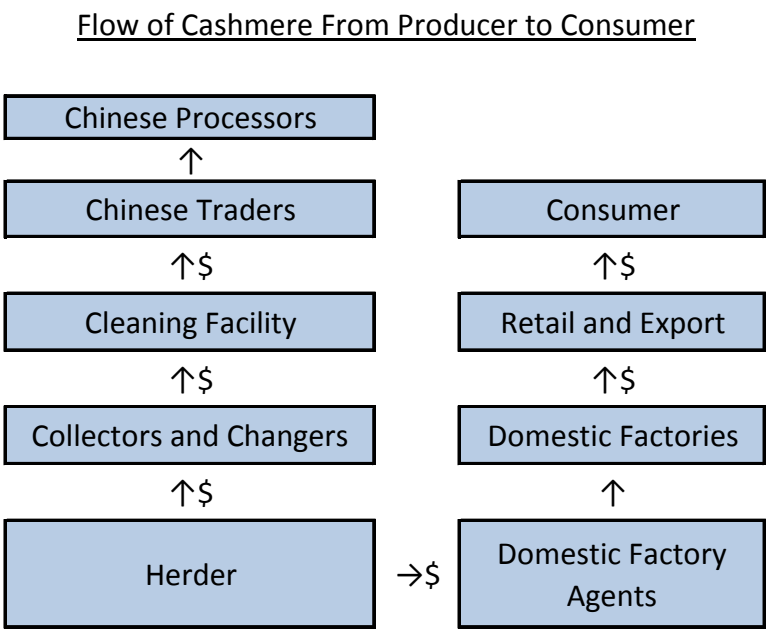
Figure 7: Hide Value Chain



Hides are another important product for herders, and a product in need of value chain improvement. Normally, herders derive hides when they slaughter animals for their household consumption, which they collect and sell as an additional income stream. But when animals die in *dzud,* hides become an important source of emergency income. Mongolian cultural norms prohibit the sale of the meat of animals that have died from indeterminate causes like *dzud*. But Hides can still be sold. Hide sales then can partially offset losses and help herders recover from *dzud.*

Hides are most often sold to changers, who sell either to the leather processors in Darkhan or Ulaanbaatar, or to international traders via the porter changer like those found near the slaughterhouses of Emeelt and Nalaih. According to interviews with processors in Darkhan, an increasing amount of sales are being conducted through agents employed by the company in effort to cut costs (Darkhan Nekki: 2013).

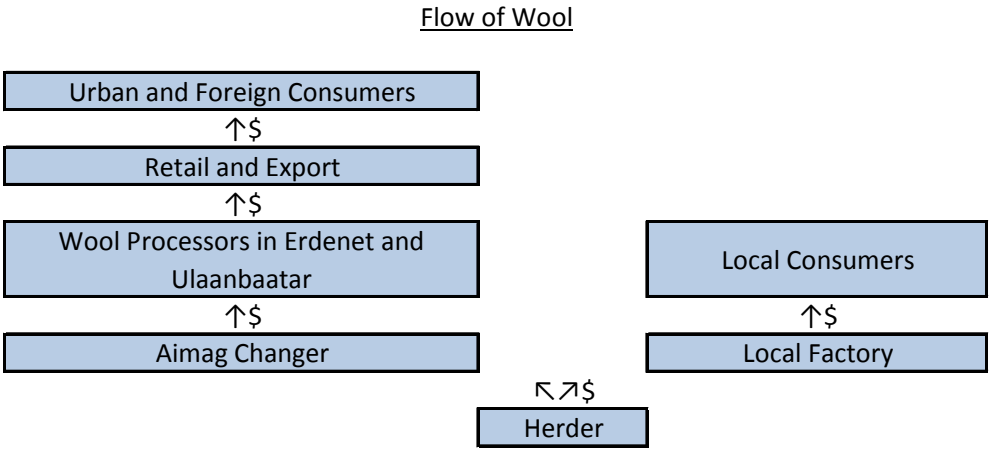
Figure 8: Cashmere Value Chain



Cashmere is an important source of cash income for herders. Herders sell it either to collectors who purchase it on behalf of Mongolian cashmere factories or Chinese traders, or to *aimag* changers (Khovd Herder: 2013, Ulaanbaatar Changer: 2013).

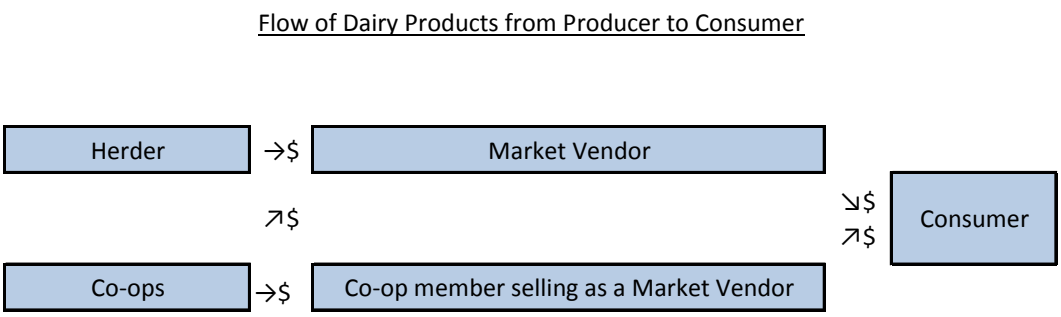
There is no official breakdown of what percentage of raw cashmere is eventually spun and woven in Mongolia versus sold to foreign manufacturers, but according to interviews with those familiar with the industry, it is believed that approximately 80 percent of cashmere produced in Mongolia is sold to China for spinning and weaving and eventual sale to consumers (Ulaanbaatar Changer: 2013).

Figure 9: Wool Value Chain



As opposed to cashmere, sheep wool is predominately domestically processed. A significant portion is processed into felt in local *aimag* centers for use as insulation in *gers,* or for export (Darkhan Felt Factory Owner: 2013). Another large portion of the wool is woven into carpets at a large factory in Erdenet.

Figure 10: Dairy Value Chain



Due to the variety of dairy products that Mongolians produce, it is difficult to determine all the different options for providing dairy products. Mongolians produce fresh milk, a variety of cream products, cheese, several different types of yoghurt, several different kinds of dried curds called *aarrual*, and fermented mare's milk. In *aimag* centers, dairy was often sold through a co-op, or a person with relationship to a herder with cattle who produced it themselves (Khovd *Aimag* Dairy Sellers: 2013, Ullastai *Aimag* Dairy Sellers: 2013, Darkhan Dairy Sellers: 2013). In Ulaanbaatar, relationship of sellers to dairy product producers was similar, though the distance between dairy producers and sellers limits the availability of fresh milk in the traditional markets of the city (Ulaanbaatar Dairy Seller: 2013). In the past few years, more mechanized dairies have been established to meet the demand for fresh milk in the city.

The Role of Risk and Incentives in Mongolian Livestock Raising

Theory of Livestock in Land Abundant Agriculture and the Role of Risk in the Mongolian Livestock Production System

Mongolia presents a unique form of transhumant livestock production focused on managing risks. Binswanger and McIntre (1987) describe the characteristics of transhumant livestock systems, in which livestock is moved around fixed pasture in a season cycle, like those which exist in Mongolia. They postulate that transhumant livestock systems are a response to input constraints and risk. In areas with sparse populations and abundant land, farm labour availability is low and infrastructure, like irrigation, is seldom available or non-existent. In this context, raising livestock provides for the accumulation of food stocks and wealth in a manner that requires minimal labour.

Binswanger and McIntire hypothesize that success of transhumant livestock will cause population growth, eventually leading to an increased supply of labour and switch from land abundance to land scarcity. Despite the long history of transhumant livestock in Mongolia, this has failed to be the case. Instead, Mongolia has become a country with an increasingly settled urban population focusing on commerce and mining, along with transhumant food production. This is not a result of failure of transhumant livestock production in the country, but a combination of exogenous factors, like the Soviet subsidies of industry and discovered mineral wealth, and endogenous limits to agricultural production.

Transhumant livestock production offers the only viable large-scale food production system in Mongolia. The country's settled agricultural potential is severely limited by its climate. These harsh conditions limit settled agriculture to a small grain belt in the lakes region and in Darkhan province and small scale vegetable farming near settlements (Suttie: 2006).

Livestock provide different benefits and limitations for coping with risk versus settled agriculture, which makes it an appropriate food production strategy in areas that face severe weather shocks. In settled agriculture, credit markets can arise as an insurance mechanism due to the collateral value of the land. The value of the land is tied to its long term productivity. A failed crop does not diminish its value. But this system depends on the long term productivity of land, a condition that does not exist in Mongolia. Without a baseline of productivity, these systems of credit for dealing with shocks cannot develop, crippling settled agriculture's development.

Transhumant livestock systems can cope with shocks without the need for the development of a system of credit. Animals do not traditionally lend themselves to credit as their value and risks are linked, though there are exceptions. If an animal perishes, it has no value, eliminating the possibility of using credit as a means of insuring against risk. Animals do have one major risk coping advantage - their mobility allows them to cope with idiosyncratic shocks by diversifying across geographic locations. For example, when facing a shock, like drought, that would

lead to crop failure for a settled farmer, a transhumant herder can move their animals to a location that is not facing drought and avoid loss.

Shocks, and adaptive risk management strategies to cope with shocks represent a critical aspect of agriculture. Mongolia offers a particularly harsh environment for any activity. Winters reach temperatures of -30 degrees Celsius, and droughts occur regularly. Sudden blizzards are common. The Mongolian term for these regular shocks related to weather is *dzud*. *Dzud* is typically translated as blizzard, but actually applies to a variety of weather shocks. Black *dzud* occurs when, in winter, there is a prolonged lack of snow and surface water freezes limiting access to water. White *dzud* is the opposite, and characterized by deep and prolonged snow cover. What little winter forage is usually available, is covered, starving livestock. It is a frequent and serious disaster which causes massive amounts of animal deaths. White *dzud* is even more serious if it follows a drought that has already limited available winter pasture. Storm *dzud* is the term best translated as blizzard. Livestock deaths caused by storm *dzud* result from animals becoming startled and running themselves to exhaustion in the snow, or becoming injured in the ensuing chaos. *Khuiten dzud* is caused by extreme cold. When winter temperatures reach extreme lows, livestock can no longer graze freely and expend all their energy in maintaining their body temperature. Serious losses occur when *khuiten dzud* follows white or storm *dzud* which have already weakened livestock (Suttie: 2006).

Due to the severity, variety, high occurrence and unpredictability of these shocks, Mongolian herders hedge not only on location as suggested by Binswanger and McIntire, but also on animal species and on products. Mongolian herders raise a mix of five species of animals depending on the local environment. While all these animals are part of the food picture, they provide different risk management services to Mongolian herders. For example, sheep provide the majority of the meat in the country, and are known for having large fat deposits which helps them survive harsh winters. On the other hand, cattle, which are not known for their resilience, provide dairy which herders dry into *aarul*, a food product that will not spoil and provides calories during the winter. Goats, while a riskier investment from an animal survival perspective, produce cashmere which represents a major source of cash without consuming animal. This is analogous to a dividend on a capital stock, providing herders with a cash flow.

Below is a typology of the type of risks in the Mongolian context, and the strategies employed by herders to cope with the risk of these shocks.

Figure 11: Typology of Risk Coping

Risk Coping Strategy	*Type of Shock*			
	Input	**Output**	**Contained**	**Covariate**
Mobility	X	-	X	X
Herd / flock species composition	-	X	X	X
Product diversification	-	X	-	-

Input shocks are those that affect the ability of herders to provide for their animals, typically drought coupled with *dzud*. Having a mix of animal species helps herders cope with this type of risk. In the case of *dzud*, different animals have varying abilities to survive weather shocks. The main weather shock that herders concern themselves with is drought. Drought limits the ability of animals to fatten in the summer time, and that of herders to gather fodder for the winter. In a drought, camels and sheep are better able to maintain body condition, which makes them better able to survive the following winter. Camels especially can eat a wide range of plants helping them to acquire additional calories in the winter. To quote an interview with a herder in Khentii province discussing animal deaths related to a sudden blizzard "Horse and sheep are patient. Cows and goats impatient, and die in *dzud* (Khentii: 2013)."

The main output risk are shocks related to commodity prices. Prices for the goods that herders produce (fibers, hides, dairy, meat, and animals) fluctuate wildly based on exogenous factors like global economic health and demand for luxury goods. For example, Mongolian domestic raw cashmere real prices fell 48 percent from January 2007 to January 2009 (Mongolian National Statistics Office: 2013). Herders cope with these risks by selling a variety of products and hoping that due to the price changes resulting from exogenous, uncorrelated factors, price decreases in one commodity will be offset by price increases in another. For example, the income loss resulting from depressed cashmere prices can be compensated for if hide prices increase. Herders require a variety of animal species to diversify their products, making output risks an additional reason for having mixed herds.

Contained shocks are events that affect either one geographic locality, or one species. These events are typically weather or disease related. Herders cope with these shocks by actively utilizing the mobility of their animals or passively relying on their mixed herds. For example, a drought contained to a particular region can be managed by engaging in *otro*, the Mongolian term for an atypical long distance migration outside their home province. This helps maintain stocks of both the herders who leave and those who stay by reducing the demand for limited water

and pasture resources. In terms of disease, the risk protection benefit of having a mixed herd is obvious. Livestock diseases, like foot-and-mouth, only impact some species, allowing herders to make up for loses by utilizing other animals.

Covariate shocks are those that impact different species of animals to different degrees. An example would be a sudden blizzard, or unexpectedly dry winter. Here again, having a mixed herd provides a passive protection. While such shocks will impact all animals, some, like goats, are more susceptible, and others, like sheep, are less. This allows herders to take advantage of the high profitability of goats in good years, while maintaining sheep stocks for liquidation after a harsh winter.

Most shocks fit into multiple categories. For example, a drought, a shock to food inputs, can be limited to one area, making it an idiosyncratic shock.

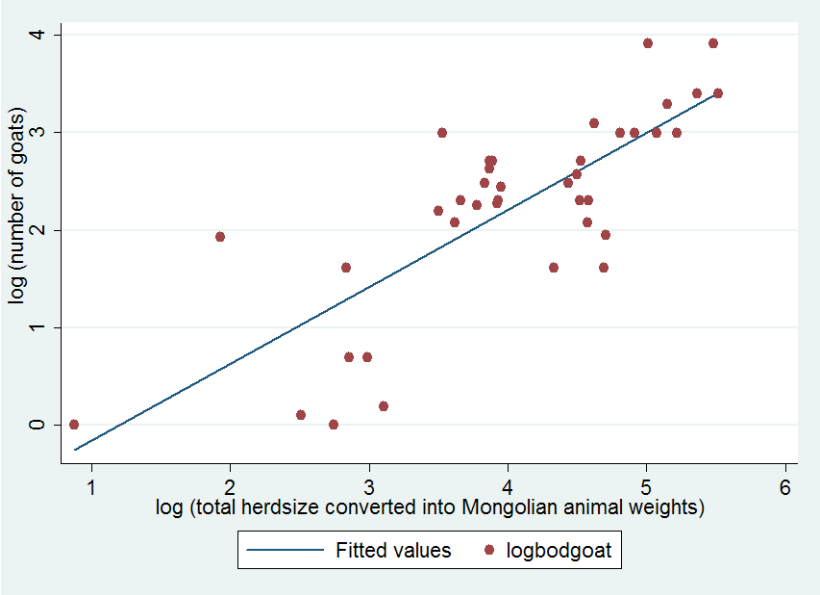
Herder Decisions about Herd Composition

As stated above, Mongolian herders choose the composition of their herds as a make-up of the five animals species, sheep, goats, cows (and yaks), camels, and/or horses depending upon wealth, inheritance, and the local environment. As their herds grow, they make choices as to which particular animals they choose to eat and sell, and which to keep. Since there is no market for buying young animals for raising, the choice of keeping an animal for additional breeding cycles as opposed to sale or consumption amounts to a choice to reinvest proceeds into these species. As time progresses, these reinvestment choices change the composition of their herds, biasing towards animals, which the herders prefer.

Investigations into herd composition reveal that as herders increase their wealth, a function of the size of their herds and the animals that make it up, they increasingly prefer other animals than to goats. To make this determination, herders interviewed were asked about the populations of different species that made up their herds. Animal population data was then transformed into *bod* units, a traditional method of valuing livestock in Mongolia across species (Suitte: 2006, Mearns: 2004). Then these units were transformed into logarithms for regression.

Regressing logarithmic variables compares the percentage change in a dependent variable with a one percent change of the independent variable. Results of this analysis found that for every one unit increase in the overall size of a herd, goat populations increase by 0.792 (0.101) percent. This means that as herd size (wealth) increases, herders choose to invest in other animals at a higher rate than goats. That is to say, while goat headcounts increase as overall herd size increases, they make up an ever smaller portion of the overall herd. These findings are consistent with other studies of herd size and herd make up in Mongolia (Maekwa: 2013).

Figure 12: Elasticity of Goat Population with Respect to Total Herd Size



This finding is also confirmed by responses to questions regarding herder investment decisions. When asked "If cashmere prices increase, will you sell more or less sheep?" one hundred percent of herders surveyed in Khentii province responded that they would sell less sheep. This amounts to a decision to reinvest the profits from raising goats, cashmere sales, into sheep, instead of goats. This seems strange to the casual observer. Cashmere was the source of the profit and cashmere comes from goats. The picture becomes stranger still when we compare the expected returns of goats versus sheep. According to market surveys conducted in Mongolia, the full future expected returns of a sheep, including annual sale of wool and the sale of the animal at year 4, is approximately 96 000 Mongolian Tugrig (MNT) versus a goat with which a herder can expect to earn 110 000 MNT.[2]

[2] The expected returns of sheep and goats are calculated by combining the each years' discounted sale value of cashmere and wool with discounted value of a goat or sheep sold in year four, was described as a typical age to sell a goat or a sheep in Mongolia. (Maclean: 2013) The interest rate of an on-demand savings account in Mongolia, which is six percent, (Khan Bank: 2013) is used as the discount rate because an on-demand savings account represents a realistic next best possible investment for the everyday herding family, making six percent a good approximation for the opportunity cost of capital.

Diminishing Marginal Utility of Cash, Risk, and Expected Returns in Mongolian Herding

The apparent disconnect between higher profitability of goat and herder preferences for sheep results from two sources: rapidly diminishing marginal utility of cash and Mongolian herders valuing the protection from weather shocks, *dzud,* that sheep provide over the cash returns generated by cashmere goats.

The rapidly diminishing utility of cash for the Mongolian herder results from transhumance and high inflation. According to Gossen's First Law, the law of diminishing marginal utility, the utility derived from the acquisition of each additional unit of a good is reduced. Cash conforms to Gossen's First Law, but because cash's primary purpose is as a medium of exchange, in economies with easy access to market where exchanging cash for goods and services has low transaction costs, the marginal utility of cash diminishes at a very slow rate. Essentially, if there is ample opportunity to walk to a wet market, drive to the grocery store, order online, or visit a hair salon, cash loses its utility very slowly. In many of societies, the ability to consume goods that denote wealth and success, conspicuous consumption, might increase the threshold value of acquiring the amount of cash necessary for making these purchases.

Inflation, fall of the purchasing power of money over time, also decreases the utility value of cash. In most economies, investment instruments like savings accounts, stock markets, and mutual funds combat inflation for an individual by offering returns to savings at a rate higher than inflation.

Transhumant lifestyle, while a critical part of the Mongolian livestock production system, and a defining aspect of the nation's culture, make market access difficult and limit consumption options thereby rapidly diminishing the marginal utility of cash. Herders have basic needs which they require cash to satisfy. For example vehicle maintenance, medicine, and nonmeat food. But Mongolian herders face high costs when accessing markets. Most herders live far from towns in areas with very limited road access. The time, fuel, and vehicle wear-and-tear necessary to access market towns makes shopping prohibitively expensive. The transhumant lifestyle also limits the utility of accruing durable goods. The need to move three or four times per year causes herder families to limit the amount of things that they own. It is not that herder families do not own or buy things, rather that they have to consider the cost of moving possessions more than families living a more settled lifestyles.

High inflation rates also reduce the utility of cash by rapidly reducing the purchasing power of savings. Inflation in Mongolia has averaged 13.2 percent annually from 2007 to 2012, peaking at 28 percent in 2008 (National Statistics Office of Mongolia: 2013). This makes keeping cash on hand an expensive undertaking. Saving in a bank does not reduce the impact of inflation by much. Savings account interest rates are only 6.7 percent (Khan Bank: 2013). This low interest rate coupled with the transaction costs of accessing distant ATMs and bank branches, dis-incentivizes saving.

After satisfying their household needs, herders find that they have very little utility in any additional cash. Its buying power is rapidly depreciating, any opportunity to spend it faces high transaction costs, and any good purchased, besides that which is consumed, incurs future moving costs. Seeing as the main service that goats provide being cash income through cashmere sales, the rapidly diminishing utility of cash discourages herders from increasing goat stocks as wealth increases. Herder families have basic needs that must be met, which is seen in the higher proportion of goats in smaller herds, but after those basic needs have been met, herders increase the proportion of other animals as herds grow in size.

Further evidence of the effect of the rapid loss of marginal utility of cash can be seen in the following case of a sudden increase in the utility of cash. Interviews with a woman selling forty sheep on the outskirts of Ulaanbaatar. When asked "If the price of cashmere increased, would you sell more or less sheep?" like herders interviewed in Khentii province, this woman answered "less sheep." As the interview continued, the woman shared that the only reason she had traveled to Ulaanbaatar to sell these forty sheep was that her son needed the money to attend university. She had been saving her wealth in sheep stocks, and now that she had a specific cash need, was liquidating these assets (Ulaanbaatar Herder: 2013).

Interviews with herders indicate that the reason they prefer to put their long term savings in sheep is that they are perceived as less risky. Sheep are well insulated by wool and large stores of fat in the tail. On the other hand, while goats benefit from the insulation that cashmere provides, they lack the fat deposits of sheep, making them more susceptible to white *dzud* that prevent animals from reaching forage and *khuiten dzud,* in which animals have to expend considerable calories to maintain body heat. While goats provide higher returns due to the annual sale of the cashmere they produce, herders increasingly value the risk protection services provided by other animals as they increase their wealth. Therefore, as Mongolians grow their herds, they increase the portion invested in sheep and horses. These are consistent with the findings in Just and Zilberman (1983), which found that as farmers' landholdings increased in size, the share of their land, on which risky crops were planted declined despite the mean returns of these riskier crops being higher. If we understand herd size to be the equivalent of farm size in Mongolia, we see the same result. The share of herds that is goats, the higher mean returns, the higher risk animal, declines as herd size increases. And the share of sheep, the lower mean returns, lower risk animal, increases.

According to herders, the risk of losing goats in a *dzud* is extreme. Interviews in Khovd province stated that *dzud* occurs approximately every five years. These interviews also stated that a herder could lose up to ninety percent of their goats, and that such a devastating loss would likely result in the herder losing their livelihood. Sheep are perceived as less risky, with herders stating that they would expect loss of approximately ten percent in a bad *dzud.* These perceived risks change the expected utility of sheep versus goats in the favour of sheep. Monte Carlo Simulation on expected returns of sheep versus goats that includes these relative risk of loss as well as fluctuations in cashmere, wool, hide, animal prices, and the discount rate reveals that while goats may have a higher value if they live, the

perceived utility of sheep raising is actually higher. Running 100 000 repetitions found that the perceived utility of raising a goat is approximately 88 000 MNT while the perceived utility of raising a sheep is the approximately 130 000 MNT.[3]

The rapid diminishing marginal utility of cash coupled with the difference in the perceived risks of raising sheep and goats explains why herders prefer sheep as they increase their wealth. Herders have cash needs that goats better provide than sheep. But once a herder household has met the basic needs for cash, the utility of more cash rapidly shrinks because of the large transaction costs of accessing markets, the cost of transporting goods that are acquired, and rapid inflation. This lack of benefit from cash above that which covers basic needs, is a disincentive to raising goats. Herders then reinvest profits from raising goats into sheep which are less risky.

Herder perceptions of risk, however, do not match the data on animal loss collected by the Mongolian National Statistics Office. According to national survey data, the average annual loss of goats since 1991 has been approximately 4.9 percent (National Statistics Office of Mongolia: 2013). Average annual losses of sheep during this period has been 4.8 percent. This changes the expected utility of raising goats versus sheep. When these mortality rates are combined with possible fluctuations of the price of livestock products, Monte Carlo Simulation reveals the expected utility of raising sheep to be approximately 115 000 MNT versus goats with an expected utility of 143 000 MNT.

This disconnect between perceived utility and expected utility likely results from a combination of the following factors:

1. Lack of data resolution — As per Binswanger and McIntire (1987), transhumant livestock systems are a form of idiosyncratic risk management. Herders are not particularly interested in the national loss rate. Rather they are concerned with more localized risk, and are attempting to avoid worst case scenarios at that level. According to one interview in Khenttii province, "There is *dzud* somewhere, every year." Taking the example of the *dzud* of the winter of 2009/2010, the country lost 22.6 percent of its sheep, and 25.3 percent of its goats. In the hardest hit Uvs *aimag*, sheep and goat losses were

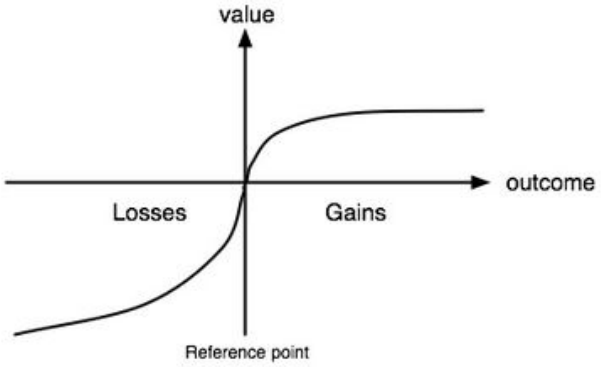
[3] A Monte Carlo Simulation was applied to the perceived risks and returns to both goats and sheep in order to understand how herders in Mongolia are calculating the expected returns of these animals. In the Monte Carlo simulation, the sale price of animals, cashmere, and hides were allowed to vary, with a normal distribution, across a range suggested by price history data. The mortality rate of animals was consistent with that described by interviews (Khovd: 2013) If animals "died" in the simulation, the recorded return of the animal was equal to the simulated value of any cashmere or wool that would have been harvested, and the simulated value of the animal's hide. If an animal did not die, the simulated value of the animal included all the harvested fibers and the simulated sale price of the animal. Labour and other costs were not included due to lack of information regarding household production functions. Since the costs of raising goats and sheep appear equal from the perspective of the herder, the non-inclusion of costs does not bias the comparisons of the relative benefits of goats and sheep. The discount rate, with an allowed to range from 3 to 10 percent, was applied. Price history of livestock and livestock products gathered from government sources. (National Statistics Office of Mongolia 2013, Mongolian Agricultural Commodities Exchange 2013)

67.4 percent and 74.8 percent. When the loss rate of goats and sheep in Uvs *aimag* from 2007 through 2010 are used as the risk of animal loss in a Monte Carlo Simulation, the expected utility of raising a goat over that period in Uvs *aimag* was approximately 48 000 MNT. The expected utility of raising sheep was 36 000 MNT.[4] Soum level data will likely demonstrate an even lar*ger* increase in relative risk towards goats.

2. Risk Aversion — Risk aversion describes an economic actor's eschewing of expected higher returns in favour of more certain, lower returns. As defined by Kenneth Arrow, a risk averse person is one that when "starting from a position of certainty, is unwilling to take a bet which is actuarially fair" (Arrow: 1971). This might partly explain Mongolian herder's preference for sheep over goats. While neither animals represent a place of certainty, sheep are less risky. From 2007 to 2010, Mongolian herders lost an average of 6.3 percent of their goats, and 5.7 percent of their sheep (National Statistics Office of Mongolia: 2013). In the *dzud* of 2009/2010, the loss of sheep was approximately, 3 percent points less than goats nationally, and 7.4 percent points less in the hardest hit *aimag*. As stated above, more granular data will likely reveal even higher losses, and an even higher increase in relative loss at the most extreme.
3. Pratt (1964) and Arrow (1971) hypothesize that while absolute risk aversion decreases as wealth grows, relative risk aversion increases. This would explain the observed reduction in investment in goats as herd size increases.
4. Prospect Theory — Prospect theory states that individuals perceive outcomes in games as wins and losses, as opposed to final states of wealth (Kahneman and Tversky: 1979). In the context of the economic game that is raising livestock in Mongolia, there is no winning in a *dzud*. There is only loss of animals, or the non-loss of animals, restricting the game to quadrant III of the Prospect Theory Utility Graph below.

[4] In this Monte Carlo simulation, instead of allowing prices to vary, the observed price for cashmere, hides and live animals was used, adjusted for inflation into 2012 MNT, which is when the animal is simulated as sold. The mortality rates of goats and sheep used were those recorded Uvs *aimag* from 2011 to 2008 (National Statistics Office of Mongolia 2013).

Figure 13: Prospective Utility Gains and Losses



(Kahneman and Tversky: 1979)

Prospect theory implies that Mongolian herders are more concerned with the loss of their animals, movement away from their current reference point, than with their final wealth outcome. This would bias their investment decisions towards the relatively less risky sheep, and away from the more risky goats, despite investing in goats to be likely more valuable in the long term.

Prospect Theory also suggest that individuals tend to overweigh small probabilities. While bad *dzud* years do occur, their frequency is erratic, and their geographical distribution highly idiosyncratic. The overall risk of animal loss is much smaller. As stated above, from 1991 to 2010, the national average annual incidence rate of animal loss was 4.9 percent for goats, and 4.8 percent for sheep. But variance of these terms is quite high. Within a winter, the incidence of animal loss across *aimag* level can range from the minimal to the extreme. An example can be found in the difference between the incidence in animal loss in Uvs and Omnogovi *aimags* during the 2009/2010 winter. Uvs *aimag* lost approximately 74 percent of its goats during the 2009/2010 winter. Omnogovi only experienced goat losses of 1 percent during that winter.

High variance tells us that while the mean of the animal loss rate on the *aimag* level is low, extreme events are very extreme. Animal losses then are not diffuse and regular, rather localized, and periodic. Mongolia is twice the size of the American state of Texas, and has the lowest population density of any sovereign country on the planet. And the utilization of transhumance is to take advantage of the fact that the risk of *dzud* is idiosyncratic and localized. But the existence of this extremeness of these events will, according to prospect theory, cause individuals to overweigh the probability of these losses.

5. Imperfect Information — It is also likely that Mongolian herders do not have access to good statistical information on animal losses. This would likely hinder their ability to make utility maximizing decisions. While this would not

fully explain the huge difference in perceived and expected utility, lack of good information about the real risks would compound the effect of risk aversion or prospect weighting.

6. Output risks — Maekawa (2013) theorizes that herder preference for sheep results from risks to output prices. Herders respond to the variability of cashmere prices, by increasing their sheep stocks as their wealth increases. However, regression analysis of data on goat populations and cashmere prices did not demonstrate a correlation between cashmere price changes and goat populations on the national level (National Statistics Office of Mongolia: 2013). While not conclusive due to the small number of years which there is data for, it does not seem that herders are taking output prices into account when determining herd make up.

Implications for Value Chain Development

The rapid diminishing marginal utility of cash coupled with the high risks of herding livestock in Mongolia makes investment in less risky animals a more attractive investment for herders than in risky animals which primarily provide products for cash sale. This suggests value chain development could, if it was able to create large enough farm gate price increases for livestock products, lead to herders deciding to sell fewer animals in order to capture the risk protection benefits.

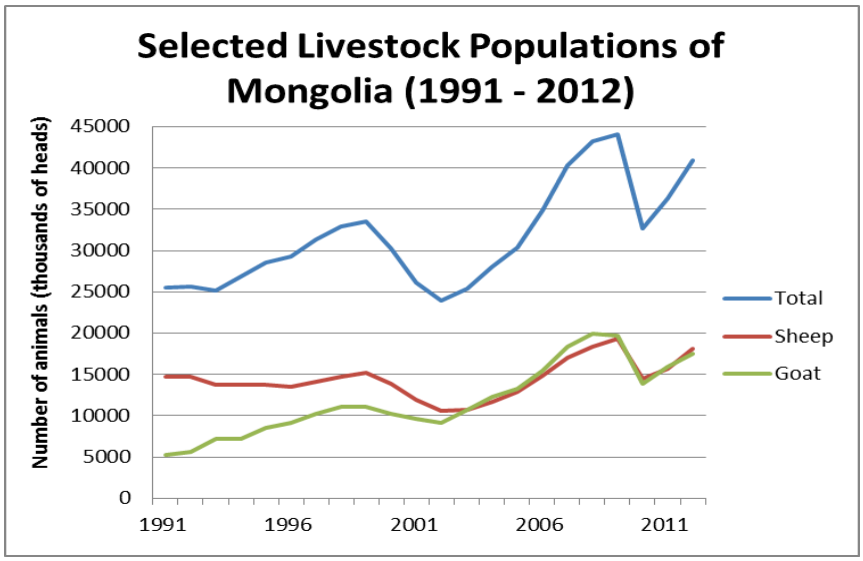
If the value chain for livestock products were to improve on the national scale this could have major impacts on urban food security. Sold animals are predominantly meant for the meat market. If herders reduce on a national scale the quantity of animals they sell to the meat market, this could result in a reduction in the meat supply. Seeing as meat, especially mutton, is a primary food source, a large enough constriction in supply would raise food prices and thus reduce food security, especially for the urban poor.

The reduction in animals supplied to the meat market could be temporary. The commonly held view is that herders require approximately 100-200 animals to be sustainable (Baas, Tessitore and Jelley: 2012, Mearns: 2004). As herders grow their animal populations, they reach a herd size beyond which they no longer wish to grow due to the labour costs involved in managing herds larger than that size and the environmental carrying capacity of their local environment. As herders reach this threshold, at approximately 200 animals (Baas, Tessitore and Jelley: 2012), they begin to engage with the meat sector more steadily. This can be understood as the point where the marginal utility of the risk protection provided by additional animals is diminishing. They are no longer selling one or two animals to those with whom they have a relationship and liquidating larger amount of animals through a changer in response to shocks, but instead supply a more constant amounts of animals. In the long run, as more and more herders hit this threshold, the quantity of animals supplied to the meat market would increase, thus lowering prices.

Unfortunately, the stress to pasture that the additional animals herders would raise in response to cash gains would likely increase the impact of *dzud.* Historically at

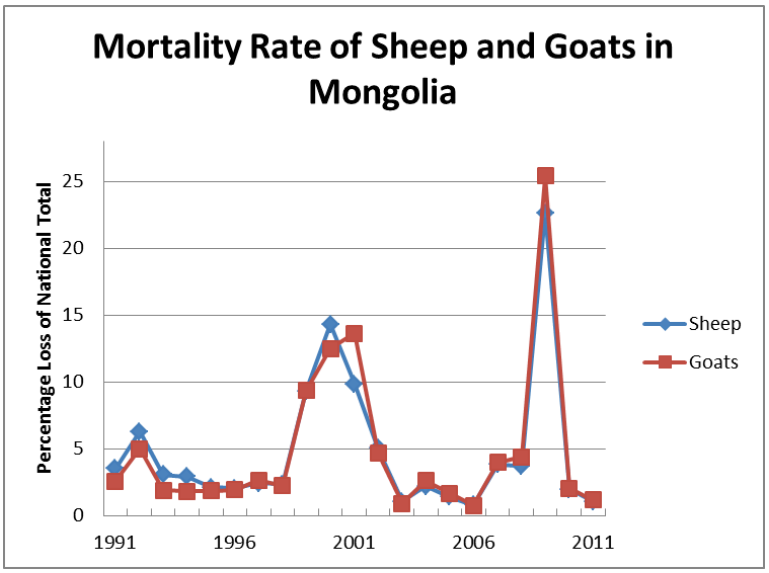
least, this appears to be the case. As animal populations have increased, losses as a result of weather shocks have increased.

Figure 14: Selected Livestock Populations of Mongolia (1991 – 2012)



Since 1991, both the total animal population and annual variation in the total animal population have increased significantly. Total animal populations have peaked twice over the 1991-2012 period. In 1999, total animal populations reached 33.5 million heads before declining after three years of back to back *dzud* to 23.9 million heads in 2002. Total animal populations peaked again in 2009 at 44 million heads and then dropped dramatically, by approximately 11.3 million, or 34.5 percent, in *dzud* of 2009/2010 (National Statistics Office of Mongolia: 2013).

Figure 15: Sheep and Goat Mortality in Mongolia



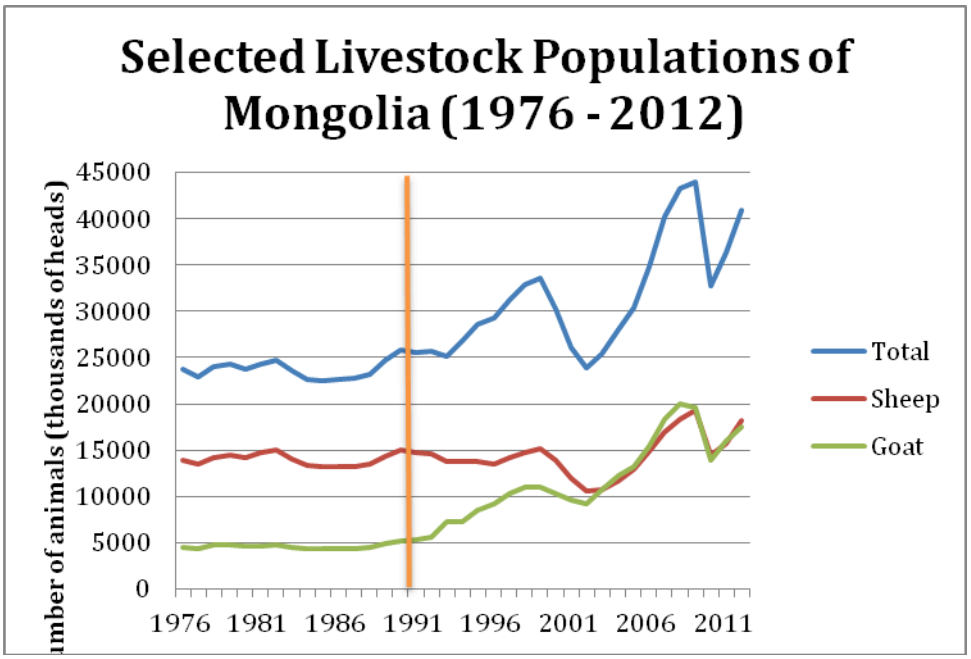
Unsurprisingly, the variation of the livestock mortality rate corresponds to the variation of the livestock populations. During the back-to-back *dzuds* of 1999-2001 the mortality rate of sheep and goats reached 14 and 13 percent respectively. In the *dzud* of 2010, mortality rates of sheep and goats reached 22 percent and 25 percent (National Statistics Office of Mongolia: 2013).

These losses have a significant impact on herders, causing many to leave the industry. Occupation in herding has been on a steady decline, with an average of 1.8 percent of households leaving the occupation annually. This has meant a decline in the number of Mongolian herding households from 289 thousand in 1991 to 207 thousand in 2012. But there is considerable variation in the rate of households leaving herding between *dzud* and non-*dzud* years. In both 2007 and 2008, the number of herding households increased slightly. Then over ten thousand families left herding after the massive losses of the 2009/2010 winter (National Statistics Office of Mongolia: 2013).

These variations in livestock mortality rates, and the corresponding loss of livelihoods for herding households, likely results from a Tragedy of the Commons (Hardin: 1968) being played out on the steppe. Since the fall of socialism, pasture within *soums* has been open access. There has been little, if any actual regulation of herd populations, but animals have been privately owned (Fernandez-Gimenez: 2006). This has created a situation where the benefit derived from an additional animal on a pasture is private, but the cost in terms of impacts on pasture and water is shared among the entire public. This has been coupled Mongolia's extremely variable environment. Most years, pastures can support significantly more animals than in *dzud* years. This causes herders to build larger and larger herds that then collapse in *dzud* from being beyond the degraded pasture's ability to feed.

Further evidence for a Tragedy of the Commons can be seen when examining livestock populations during and after the Mongolia People's Republic.

Figure 16: Selected Livestock Populations of Mongolia (1976 – 2012)



When Hardin proposed the concept of the Tragedy of the Commons, he suggested two solutions: privatization of the commons or government regulation of it. Before 1991, the state regulated livestock populations through cooperative managers. This regulation of livestock numbers combined with State Emergency Fodder Fund reduced the impacts of weather shocks. After 1991 and the privatization of livestock, the number of total livestock increases as well as total number of animals lost and the livestock mortality rate during *dzud* years.

Even at the peak of livestock populations in 2009, the number of animals to herder households was 194 per household (National Statistics Office of Mongolia: 2013) which falls short the threshold herders are believed to begin to regularly engage with the commercial market. This ignores the fact that animal assets are not equally distributed between households, meaning that many households own below this amount of livestock. As of 2001, the share of all livestock-owning households with less than fifty head of livestock was 40 percent, while as many as 90 per cent of households with livestock held fewer than 200 head (Mearns: 2004). This implies that a significant amount of herders will have to raise the headcount of their herds to reach a viable herd size.

The *dzud* of 2010 demonstrated 194 animals per herding household to be unsustainable. Moreover, climate change and desertification threaten to further reduce the carrying capacity of Mongolia's pasture. (Murphy: 2011, Marin: 2009). This puts in doubt the ability of Mongolia to provide enough animals for all the 207 000 herder households to reach a herd size where they will engage with the commercial sector.

An Overview of Programmes for Ruminant Production in Mongolia

The FAO of the UN, through the Livestock and Agriculture Marketing Program (LAMP), is one of the major organizations working to improve livelihoods for herders in Mongolia. FAO in Mongolia is engaged with several activities focused on small herders including activities targeted at helping herder groups develop forage and feed production, improving the capacity of local veterinary services and small scale investment training programmes in addition to plans to work on value chain development (Maclean: 2013).

What follows is an overview of two other projects working to improve the livelihoods of herders in Mongolia. First is the Index-based Livestock Insurance Program (IBLI). Operated by the Mongolian government with financing and technical assistance from the World Bank and other organizations, the IBLI assists herders with risk management by providing insurance against livestock losses and incentivizing traditional long-range migration in the face of weather shocks. Second, is the Green Gold Pasture Ecosystem Management Project supported by the Swiss Agency for Development and Cooperation (SDC). This project works with Pasture User Groups in order to build the local capacity to best manage Mongolia's grasslands.

This section concludes with a selective summary of other projects working with small holder ruminant production in Mongolia.

The Index-based Livestock Insurance Program (IBLI)

Started in response to the significant loss of livestock that resulted from the *dzuds* of 1999-2002 and the non-adoption of traditional insurance, IBLI assists herders in Mongolia by providing insurance for their animal assets. As opposed to a traditional insurance plan that covers an individual against a loss of specific asset and where payments are made in response to proven claims of the loss of that asset, the IBLI insures herders based on the mortality rate of animals in their *soum.* When the losses of the *soum* of the herder reach six percent, the herders receive indemnity payments equal to the value of the livestock they have insured in excess of 6 percent, regardless of their own losses. Premiums are based on historical data on losses of that particular animal species in that particular *soum* (Index-based Livestock Insurance Program: 2012).

The workings of the programme are best explained through a hypothetical example. Suppose a herder family in Khovd *soum* decides to insure their 50 sheep. For sake of the example, suppose sheep in Khovd *soum* are currently 100 000 MNT and the premium rate is 2.5 percent. If they wish to insure the entire value of their sheep, the premium would be 125 000 MNT (50 sheep x 100 000 MNT x .025 premium rate). If that is unaffordable for the herder family, they can choose to insure less than the full value of the sheep in exchange for lower indemnity payments if losses occur.

Let us suppose that during winter that 15 percent of the sheep die in an extreme *dzud*. Mortality has exceeded the mortality threshold of 6 percent, which now acts as a deductible, meaning that herders will receive indemnity payments of 9 percent (15-6) of the value they have insured their sheep. This means, if the herder family had insured their 50 sheep at 100 percent value it receives an indemnity of 450 000 MNT (5 000 000 MNT x .09). If the family had only insured 50 percent of the value of their sheep the payment would be 225 000 MNT (2 500 000 MNT x .09). This is regardless of whether or not they lost 15 percent of their sheep. Herder families with animal losses above and below fifteen percent will still receive payments equal to nine percent of the value of the amount they insured (IBLI Program 2012). Even if herders leave the *soum* to avoid the *dzud* and thus suffer lower losses, they still receive the same indemnity payment (Yadamsuren: 2013).

The indexing of indemnity payments saves costs and encourages herders to participate in the programme. The indexing of indemnity payments saves administrative costs that would incur if claims had to be verified. There is no need for insurance adjusters to inspect each loss, or potential for conflict over whether a particular animal was lost, or the value of the animals insured. Payments are instead determined by the results of the mid-year agricultural survey conducted by the National Statistics Office, and the amount of the payment is based on a predetermined value set by the herder. Indexing also encourages herder participation by making the conditions on which they will receive an indemnity payment explicit and by removing any burden on them to prove the loss of a particular animal or loss rate of animals.

Indexing also incentivizes other risk management strategies like long-range migration, also known as *otro*. Because indemnity payments are based on the mortality rate of animals for the entire *soum*, herders will profit if their herd's mortality rate is below average for the *soum*. This applies even if the herder leaves the *soum* in order to reduce the loss of animals. The insurance payment then acts as an additional financial benefit for herders when considering *otro.*

By encouraging *otro*, IBLI helps reduce stress on pastures during *dzud*. The indemnity payment increases the profitability of *otro,* thereby increasing its utilization. While particularly beneficial to the herders whose animals are moved in order to avoid the *dzud*, the departure of animals from an affected *soum* benefits the remaining animals by reducing the number of animals the limited pasture needs to feed. By reducing the total number of animals on the affected pasture land, it is better able to provide for the remaining animals which reduces the mortality rate for the entire *soum*, not just for the herder that undertook *otro*. This produces a benefit for herders who did not undertake *otro*, by lowering their losses and to the IBLI programme which will be making lower indemnity payments than if all the herders had remained (Yadamsuren: 2013).

Indexing indemnity payments to *soum* level livestock mortality rates flips the moral hazard problem of traditional insurance. Traditional insurance creates a moral hazard in that the entity paying for the negative outcomes of taking risks is not the one deciding to take that risk, which in turn encourages risk taking behaviour. This

changes the conditions under which the individual is insured, thereby undermining the actuarial soundness of the product (Arrow: 1968). The IBLI programme, by adding an additional incentive for herders to engage in long-range migration in the face of *dzud,* discourages the risky behaviour of keeping animals in an affected pasture. The incentivized behaviour produces a positive externality in that it reduces burdens on pastures affected by *dzud* which will allow them to better provide for remaining animals thereby reducing the mortality rate that results from weather shocks on herds that do not undertake *otro.* In turn, the IBLI sees a reduction in its indemnity payments through the reduction in the livestock mortality rate. Therefore, instead of creating a moral hazard, indexing indemnity payouts for livestock loss creates a moral incentive that encourages risk management.

The IBLI programme also works to spread risk among the three participants in the programme: herders, private insurers, and the government of Mongolia. Species losses of less than six percent are the responsibility of the herders. If the mortality rate for that species of livestock is below this threshold, herders receive no payments. If the mortality rate is greater than six percent, herders are still responsible for the deductible, but they begin to receive indemnity payments equal to the difference of the livestock mortality rate and six percent. Private insurance companies pay for losses above six percent and less than thirty percent. Any losses in excess of 30 percent become the responsibility of the Mongolian government.

The IBLI programme appears to be successful at enrolling herders into insurance plans. Since the programme's establishment in 2006, the number of herder families enrolled has increased by an average of 38 percent a year, reaching approximately 16 000 families enrolled in herding or a little over 7.5 percent of the herder families nationally. As of 2012, 100 percent of indemnity payments have been made (IBLI Program 2012, National Statistic Office of Mongolia: 2013).

The IBLI programme is overseen by the Project Implementation Unit at the Mongolian Ministry of Finance. The programme receives funding and technical support from World Bank, and the Swiss Agency for Development and Cooperation, SDC (IBLI Program: 2012).

There are only two evident concerns regarding the IBLI programme. First, the income and wealth breakdown of herders who do and do not participate in the programme is unclear. It is possible that poorer herders would like to participate, or increase the amount of livestock they insure, but are unable to due to the cost of the premium. These lower income herders are less able to undertake *otro* due to the cost associated with traveling these long distances, further disadvantaging them when facing *dzud* (Murphy: 2011). These herders still benefit from the reduced burden on pastures resulting from the livestock herds that were moved, but seeing as they are the least able to afford the losses associated with *dzud*, they are likely the ones who would benefit most from receiving an indemnity payment.

The second concern is not directly a concern regarding the IBLI programme, but of *otro* itself. When poorly managed, the movement of livestock through a territory can cause *hoofed dzud*, loss of pasture due to over stress from livestock passing through a territory on a long range migration. As much as the IBLI encourages *otro*, it can

potentially encourage the main cause of *hoofed dzud.* Luckily, *hoofed dzud* can be avoided if *otro* is properly managed by herders, local government leaders and strong cross-sectional institutions (Fernández-Giménez, Batkhishig, and Batbuyan: 2012).

SDC's Green Gold Pasture Ecosystem Management Project

The Swiss Agency for Development and Cooperation's (SDC) Green Gold Pasture Ecosystem Management Project (Green Gold) has been supporting herders since 2004. The main objectives are:

- To test new technologies for pasture improvement and forage production to be adopted by herders.
- To introduce co-management schemes for managing pastures involving herders, local government and other relevant stakeholders to be adopted by the different actors in selected project sites.
- To test and demonstrate an enabling legal environment for pasture improvement and co-management (SDC: 2013).

The Green Gold focuses on building the capacity of local pasture user groups (PUGs) to implement technical and collective action solutions to pasture management problems. These groups are sponsored by the local government with the expressed purpose of developing Pasture Management Plans. The programme assumes that these groups will be able to learn through the implementation of increasingly complex collective management actions, and that when enabled by a favourable legal framework, be able to manage the pasture effectively (Usukh et al: 2013).

PUGs face a variety of challenges in achieving the objective of being able to effectively undertake community-based natural resource management (CBRM) in their areas, beyond access to technical knowledge. Groups always face transaction costs when organizing, communicating and coming to agreements. Due to transhumance, Mongolian herders are diffusely settled and move regularly, which makes the transaction costs of organizing into a PUG are high. This favours organization into smaller units in order to keep the costs of organizing, communicating and collective actions small. But this is in tension with the need for access to a larger territory in order to be flexible and mobile, especially in times of *dzud*, which favors larger PUGs. Another challenge PUGs face is the ability to exclude non-members from their pasture. Currently, herders are able to move across their *bags* and *soums* without regulation as long as they respect "customary" use rights of others, like the reserve of winter and spring pasture. During a *dzud,* having well-maintained reserve pasture becomes attractive to herders escaping poor conditions in other areas. Entry into an *aimag* with livestock requires the approval of local government leaders. Effectively, this means in time of *dzud* outsiders can access these reserve pastures, but the duration is limited. This is consistent with existing cultural norms of reciprocity in dealing with the impacts of negative shocks (Fernandez-Gimenez: 2006). According to interviews, a fee is also paid to local government when crossing *aimag* borders with livestock for the purpose of changing grazing sites. It is unclear how the amount of that fee is determined, who exactly

that fee is paid to and how that fee benefits herders from the area receiving herders escaping *dzud.* If a fee is charged by local government officials to herders using PUG managed pasture, but PUG members do not receive any benefit from that fee, it could be a large disincentive to engage in responsible pasture management (Ulaanbaatar: 2013).

To date, the Green Gold project has implemented many successful projects in areas of pasture rehabilitation, improving hay production and forage and training local experts. As of 2012, the project works with 679 PUGs, reaching approximately 18 000 herders (SDC: 2012).

Other Programmes for the Support of Ruminant Production in Mongolia

The following is a list of other organizations working with herders in Mongolia:

- Mercy Corps - Mercy Corps has been active in Mongolia for over 15 years. In that time, the organization has operated multiple projects aimed at improving herder livelihoods by promoting value chain development and increasing disaster preparedness.
- Currently, Mercy Corps operates two projects that directly assist herders in Mongolia. First is the Leveraging Tradition and Science in Disaster Risk Reduction in Mongolia project which works to improve the weather forecasting capacity of the Mongolian government and to provide herders with real time forecasting information in order to help them be prepared for sudden weather shocks. Second is the Productive Agribusiness Chains Support project which promotes value chain development by providing herders with information on improved techniques for the production of meat and dairy as well as encouraging the adoption of said techniques (Mercy Corps: 2013).
- United Nations Development Programme (UNDP) - UNDP works with partners both in the Government of Mongolia and in civil society to promote sustainable development and the achievement of the Millennium Development Goals. UNDP sponsors a variety of projects targeted at poverty reduction, environmental protection, and improved democratic governance. Current projects include the promotion of micro-insurance to reduce the poor vulnerability to economic shocks and an ecosystems based approach to maintaining water security in the country (UNDP: 2013).
- International Fund for Agricultural Development (IFAD) - IFAD works with the rural poor to enable them to increase returns to their livelihoods through the Market and Pasture Management Development Project. This project has two components: market development and Pasture management and climate change adaptation. The market development component focuses on identifying demand for livestock products and directly linking herders to that demand, and supporting the start-up of small enterprises geared at livestock product processing. The pasture management and climate change adaptation

component aims at facilitating the start-up of Pasture Herder Groups, not to be confused with Pasture *User* Groups, for collective management of the steppe and providing these groups with training and resources to adapt to climate change. (IFAD: 2012).

Policy and Research Recommendations

Policy Recommendations

As argued above, herders are incentivized to invest profits gained from the sale of animal products into less risky animals. The investment in additional risk protection leads to reduced quantities of animals being sold for meat in the short run, and additional stress on pastures combined with weather variability prevents a new equilibrium being achieved in the long run. This stems from the rapidly diminishing marginal utility of cash for herders and herders' need for risk protection. The following recommendations for increasing the sustainability and incomes of transhumant herders in Mongolia focus on different, but complementary initiative areas: reducing risks by strengthening formal and informal risk management institutions and managing the Tragedy of the Commons problem, and improving social assistance programmes.

Recommendation 1: Extend the IBLI with a separate voucher or conditional cash transfer programme

Crop insurance is a common suggestion for helping farmers cope with yield risks. Mongolia already has a programme to deal with yield risks in livestock production: the Index-based Livestock Insurance programme discussed above. This programme seems for the most part successful.

The only policy recommendation regarding the Index-based Livestock Insurance programme is to assist the poorest herders to purchase policies. One of the unfortunate weakness of the IBLI programme is that *otro*, long-range migration, is a strategy that primarily only the more well-off of herders can afford (Murphy: 2011).

Extending the IBLI programme to the poorest of herders is probably best achieved not by adjusting the insurance programme itself, but providing poor herding families with vouchers or conditional cash transfers to purchase insurance plans for their livestock through a separate programme. The poorest families are described by the literature as the least able to undertake long-range migrations in the face of *dzud.* While they benefit from the reduction of stress on reserve pastures created by herding families that have undertaken long range migrations, poor families are most likely to receive the brunt of the bad weather, and are the least likely to have purchased insurance policies to cope with its impact. Assisting herders too poor to purchase insurance policies for their animals through a social assistance programme will not only help these families cope with losses, but will help ensure the solvency of the Index-based Livestock Insurance programme. Such a programme should be kept separate from the Index-based Livestock Insurance programme itself in order to avoid undermining the mission of the insurance programme, which is helping herders cope with risk, not poverty alleviation.

A programme aimed at helping poor herders participate in the insurance programme could be accomplished with vouchers that subsidize purchase of policies. Such a programme could go so far as to provide different levels of subsidy depending on the poverty or vulnerability level of the participant. But perhaps participation in the

Index-based Livestock Insurance programme would be better achieved through a conditional cash transfer programme. Conditional cash transfer programmes merge social assistance programmes with efforts to alleviate the systemic causes of poverty by making the cash transfers of the social assistance programmes conditional on the recipients participation in an activity that develops long term capacity. An example would be the Progresso/Opportunidades programme in Mexico, which provides cash transfers to poor families conditional on their children's attendance in school. A conditional cash transfer programme aimed at helping poor herder families could be designed to be conditional on purchase of livestock insurance policies that the transfer would cover. This could have the twin benefits of helping to alleviate poverty and vulnerability in Mongolia's agricultural sector in the short term as well as helping increase capacity for coping with the impact of shocks in the long term (De Janvry: 2008).

Recommendation 2: Assist existing efforts reduce the impact of *dzud* by promoting cross-boundary institutions

As identified earlier, as animal populations increase burdens on pasture increase. This causes a Tragedy of the Commons, in that as herders accrue a private benefit from over consuming pasturelands by increasing herd sizes. This over consumption reduces the ability of pasture to provide for animals during *dzud,* thereby increasing the severity of losses. Therefore it is important to undertake strategies that reduce the burden of livestock on pastures.

There are three identified solutions to the tragedy of the commons: privatization of the resource, regulation of the resource, and common pool property management.

1. Privatization of the Resource: When Hardin first put forth the idea of the Tragedy of the Commons, privatizing the resource was his preferred solution (Hardin: 1968). He argued that if marginal cost accrued totally to the owner of the resource and was not spread across the entire community that would incentivize the optimal rate of use of that resource.
2. Regulation of the resource: Hardin's second best solution to the Tragedy of the Commons was the regulation of access to that resource by the government.
3. Self-governing Institutions for Common Pool Resource Management: Self-governing institutions have demonstrated that they can be effective managers of natural resources. Ostrom identified conditions that make local, self-governing institutions effective managers of natural resources (Ostrom: 1990, Poteete, Janssen and Ostrom: 2010).

Of the three possible solutions to the Tragedy of the Commons in the Mongolian case, the promotion of self-governing institutions for the management of pasture seems the most viable. Privatizing Mongolia's range does not seem a viable option. Ensuring that private property rights were respected in an area so large and sparsely populated seems cost prohibitive. Privatization of pasture would limit the ability of herders to leave home pasture in the face of *dzud*, and likely force more herders from the occupation. Mongolia has regulated pasture access and livestock

populations during the socialist period through the *negdels* system (Fernández-Giménez: 1999). Although this was effective at reducing severe animal losses due to *dzud*, the national herd was kept significantly smaller, and still the system depended heavily on subsidies from outside Mongolia (Suttie: 2006, Mearns: 2004).

Of the many conditions that Ostrom identified as necessary for common pool resource management, meeting clearly defined boundaries for the effective exclusion of outside parties seems most tenuous. As already identified, *otro* is an important aspect of managing *dzud*. It is important to ensure that the practice continues, but properly managed.

In order to ensure that cross-boundary movements do not overly burden pasture maintained by PUGs it is important to strengthen cross-boundary institutions consistent with suggestions of researchers in the subject area (Fernández-Giménez, Batkhishig and Batbuyan: 2012). Also, seeing as the herders participating in PUGs are undertaking extra efforts to promote the proper maintenance and health of pastures under their charge, it is important that they receive compensation for that effort when herders that are not members of the PUG use that pasture when fleeing *dzud.*

Recommendation 3: Focus value chain development on meat and hides

In conjunction with risk protection, value chain development has the potential to improve the returns of livestock raising to herders. But it is important to focus public value chain development on meat and hide supply chains as opposed to the fiber supply chains.

Improving meat quality through investment and supply chain incentives

Improving the meat supply chain presents many challenges in terms of hygiene, infrastructure, and changes in cultural norms. Because these measures can increase livestock product value, however, they also present incentives to be financed by a combination of private and public agency. To the extent that they also reduce transactions costs, they can improve food availability and affordability in urban areas.

In many ways, the biggest challenge to supply chain development is to incentivize higher meat quality meat for herders. The increase in meat quality in the Global North, improvements in meat quality have been achieved in large part through integration and institutional change, including contracting and producer cooperatives. Vertically and horizontally, these innovations have reduced vertical transactions and market access cost, while creating conditions favourable to input specialization (e.g. feed grain production, transportation, animal health products and services, see Ifft and Zilberman: 2012). Because of demographic dispersion and relatively low yield agricultural land, Mongolia may not be able to pursue these complementary strategies effectively. While the country's infrastructure is improving, its current level of development would not allow such specialization outside of the central region of the country. Moreover, it is unclear if Mongolia's environment would allow for grain production at a level that could sustain the specialization in animals that undertaking a similar form of integration and contract livestock production as the Global North might require.

Conditions at slaughterhouses should be improved and public awareness campaigns should inform urban dwellers of the lack of sanitary conditions their meat is being processed in combination with inspections of meat processing facilities.

Improving hide quality and value through contracting

Developing the hide value chain presents an additional means of helping herders cope with risk, through helping them recover from animal losses due to weather shocks. As opposed to meat, hides can be sold if an animal dies from a natural causes. This means that when herders lose a significant amount of animals, they at least can recover a portion of the value of the animal from selling its hide.

The main value chain development that hides require is the prevention of damage from insects. According to interviews with leather processors at Darkhan Nekki, insect bites on livestock can damage the skin, making portions or even entire hides unusable for making garments. Leather processors can only use approximately 65 percent of the hides, the remaining being too damaged. This produces a considerable amount of wasted raw material. This is costly for the leather processors which buy animal hides in bulk without knowing the quality of every hide. According to a manager at Darkhan Nekki, before 1991 animals were treated to prevent damage from insect bites through programmes funded by the government, indicating that the problem can be managed (Darkhan Nekki: 2013). Increasing the quality of hides would benefit both the herder who could command a higher price for the hide, and the processors that would be able to waste less money purchasing hides that are unusable.

Developing the hide value chain will require the development of a programmes/methods for control of these insect pests that is appropriate for Mongolia's current socio-economic context. But such a programme is well within the capacity of FAO and/or the Mongolian Ministry of Agriculture. Developing the hide value chain will also require the industry to overcome the information problem of hide quality. As currently organized, most of the hides appear to be traded through *aimag* changers that mix hides from a variety of sources. This disincentives both the leather processors from offering higher prices because they have no mechanism for ensuring the hides for sale are of any particular standard of quality, and herders from improving the quality of the hides they produce by preventing leather processors to pay for that quality improvement.

A pilot project for developing the value chain for hides could be designed and operated by helping a herder co-op contracting with a leather processor that has in-house agents for procuring hides like Darkhan Nekki. This project could engage local veterinary services and company agents to train herders how to prevent insect damage to animals, and perhaps provide material assistance. The co-op could then sell its hide production to the leather processor through the company's agent. This would ensure the leather processor that the products were of sufficient quality to justify a higher price, and ensure that herders would profit from any investment made to improve hide quality. In the long term, some kind of inspection/certification system could be established to ensure that herders receive higher profits if they make the investment to improve the quality of their hides.

Publically funded value chain development should not focus on the two main animal fibers, wool and cashmere. Wool provides poor returns to herders. Its sale price is low, and it is expensive to transport due to the large volumes of product necessary to justify sales beyond local markets. Moreover, stiff competition from other wool producing countries with easier access to the international market will keep transport expensive Mongolia uncompetitive. Therefore, value chain development of wool will likely not produce much benefit for herders. Cashmere on the other hand will likely attend to itself. As stated previously, raw cashmere production benefits from demand from Chinese textile manufactures looking to produce cashmere garments. Chinese merchants do not need any supply-side convincing to purchase Mongolian cashmere. Their demand for cashmere is dependent upon world demand for cashmere products. Any improvement to cashmere, beyond trying to maintain or improve the quality of the genetic stock of Mongolian goats, will likely not lead to higher farm gate prices for the fiber when compared to non-development of the value chain because demand from China will be driving prices.

The boutique fibers, yak wool and camel wool, might be other appropriate products for value chain development. The desire to improve returns to herders for these products stems in part from the desire for the continued inclusion of both these animals in the Mongolian livestock system. Both yaks and camels offer large risk protection benefits. Improving the value chains for both these animals will help the preservation of these animals as well as increasing returns to herders.

Recommendation 4: Avoid futures contracts for livestock products

A common tool for coping with output price uncertainty are futures contracts, but it seems difficult to imagine that they are feasible tool in Mongolia. Futures help avoid output price uncertainty by locking in the price of the outputs earlier in the production cycle. This protects both buyer and seller from price shocks in the commodity. However, futures contracts require several conditions to be successful. Of these conditions, neither the need for a futures contracts to be more effective at reducing risk over a cross-hedge nor the requirement of the liquidity costs of promising one's product to a future buyer not too much more than the liquidity costs of the current hedge do not appear to be met in Mongolia (Brorsen and Fofana: 2001).

Futures contracts should be more effective at reducing risk than the existing cross-hedge. As mentioned above, Mongolian herders already employ diversification with respect to output price risk by providing a variety of products that allow them to offset price declines in one commodity with gains in other commodities. This diversification strategy is partly in species, which includes protection against the risk of *dzud* because of varying degrees of cold hardiness across species. A futures market aimed at reducing price variability might not offer appropriate incentive to diversify animal species, and offers limited risk management capacity to herders.

Another necessary condition for futures market success is that liquidity costs not exceed those of the current hedge system. Offering an animal to a buyer through a futures contract would sacrifice the ability to liquidate that asset in the face of a positive shock, diminishing the appeal of a futures contract.

Therefore, while livestock output prices vary considerably and sudden drops in price of these price represent a significant risk to Mongolian herders, it is difficult to see how futures contracts could be instituted in the context of transhumant livestock production in Mongolia.

Research Recommendations

Incentive Compatible Cash Grants to Simulate Value Chain Development

Much of this analysis results from attempting to understand the observation that as wealth grows, the rate of growth in investment in goats declines, and herders own statements that an increase in cash incomes from cashmere would mean reinvestment in their sheep stocks. It would behoove policymakers, especially those interested in value chain development, to better understand how herders invest increased returns from sales of livestock products.

A randomized control trial (RCT) could be implemented that matches increases in returns of cashmere, wool and hides with detailed household economic surveys. Households would be randomly selected to receive market price, market price plus five percent, market price plus ten percent, market price plus fifteen percent for one or all of the livestock products they already produce, for one or more years. These grants would be matched with detailed household baseline surveys, economic surveys, and annual or semi-annual follow up surveys to track the effect of these additional profits on herd composition and health, *otro*, and household spending.

While such a study would not be definitive on the efficacy of value chain development because those opting in to taking on additional activities to develop their products are likely different in some unobserved manner to those not undertaking value chain development, such information on household spending would likely be informative. Moreover, such insights on herder household spending would be informative when considering other initiatives to help herders increase the returns of their livelihood activities.

Ex-Ante Impact Analyses for Projects Aiming at Increased participation in the IBLI and/or Hide Value Chain Development

While efforts to increase participation in the IBLI and increase returns to hides due to their unique position to help herders recover from loses are recommended above, the impacts of any intervention should be monitored and evaluated. Therefore, if either of these projects are undertaken, their impact assessment strategy should be designed before implementation.

For an IBLI voucher/conditional cash transfer programme aimed at increasing participation, the impact could be assessed with a clustered randomized control trial (RCT). This would be designed to measure the benefits of participation in the

programme , as well as externality benefits to those herding in the same pastures.[5] Eviidence from a rigorous RCT would allow policymakers to see if *otro* program incentives can mitigate *dzud* impacts on herders sharing winter pasture with IBLI participants.

For a programme targeted an hide value chain development, an RCT presents limited effectiveness due to the necessity of operating such a project through herder groups. Those opting to join herder groups are fundamentally different from those opting not to join herder groups, making them poor comparison populations. It is likely better to use a difference-in-difference design in order to compare gains in returns to herder groups participating in hide value chain development, to those of groups that do not.

[5] See e.g. Miguel and Kramer (2004).

Conclusions and Extensions

This report has examined the role of risk and agency relationships in the Mongolian livestock supply chains, with the goal of elucidating key factors for policymakers seeking to improve rural livelihoods and domestic food security. Specifically, this report has presented a brief overview of Mongolian transhumance, historically and based on direct observation of today's pastoral communities. In particular, we have examined the roles of low income household and enterprise agents in the Mongolian livestock production system, tracing the flow of animals and animal products from pastoral smallholder producers to urban consumers. This report has investigated the impact of risk and rapidly diminishing utility of cash on herder investment decisions and profitability. Also included was an overview of current interventions intended to benefit smallholder producers and intermediaries. Finally, we recommended projects that can help poor herders participate manage and cope with risk and identify topics related to Mongolian ruminant production in Mongolia that warrant further study.

Better understanding of the impact of risk, and how herders respond (ex ante and ex post) to risk, is critical to designing and implementing programmes and policies to improve their profitability and food security. The results of this study, including preliminary supply chain data, herders' own testimony, and a review of risk oriented economic theory opens a pathway to achieving this understanding. With more determined commitments to local data development and analysis, insights about risk and response in herders' lives can inform the design and implementation of interventions to that sustainably increase small herders' returns to livestock and improve the livelihoods of the nation's rural poor.

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Glossary

Aimag	Province of Mongolia
Dzud	Extreme weather or other event resulting in death of livestock
Ger	A traditional, portable felt tent used by Mongolian herders. Also known as a *yurt*
Otro	Migration with livestock in response to dzud
Soum	A rural district in Mongolia
Transhumance	The practice of moving livestock from one grazing ground to another in a seasonal cycle